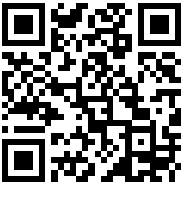
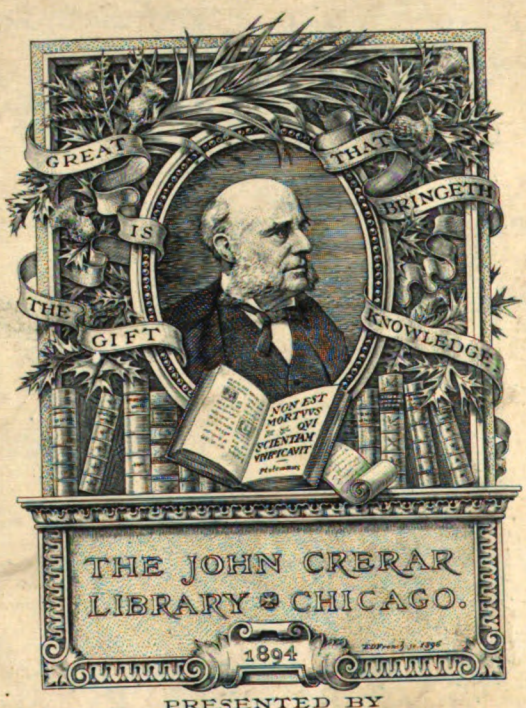
Landis Grinders

How to Use Them

Landis Tool Company
Waynesboro, Pa.
U. S. A.





PRESENTED BY

Landis Tool Company

Landis Tool Company

The Eddy Press Corporation
Winchester, Va., and
New York City

Landis Tool Company

Manufacturers of

Grinding Machines

for Cylindrical *and*
Conical Surfaces

Universal Grinding Machines

Plain Grinding Machines Gap Grinding Machines

Crank Grinding Machines

Internal Grinding
Machines

1906

Main Office and Works

Waynesboro, Pa.

U. S. A.

Preface

IN publishing this book it is our intention to assist those that are not familiar with the operation and use of Grinding Machines. We desire to have them well understood, properly cared for, and profitably operated.

INTRODUCTION

WE publish this book with the object of submitting to the users of Grinding Machines such suggestions as in our experience have been found valuable in properly caring for and profitably operating them.

Grinding machines are recognized as producers of accuracy and considered indispensable for finishing tools, hardened parts, etc. There are many concerns who use them for finishing manufactured parts also, yet there are very many kinds of pieces on which a grinder could be economically used to which it has not yet been applied. There are but few metal working manufacturers who could not advantageously use one or more grinding machines. It has been claimed by many concerns that the character of their work is such that a grinder would have but little value; this is due generally to the fact that they do not require accuracy—that polish is all they need.

Grinding machines as now constructed are capable of producing finished pieces, whether accuracy is required or not, in less time than it can be done in any other way. It is possible to finish by grinding almost any material, but on some the result is more quickly obtained than on others. Our machines will finish soft or hard steel, cast iron, brass, copper, rubber, fibre, etc.

Ground bearings in all cases are conceded to be the most accurate, and makers of machine tools, printing presses, steam engines, gas engines, automobiles, sewing machines, pumps, laundry machines, dynamos, roller bearings, type writers, sawmills, threshing machines, etc., know that when they have finished the spindles of their machines on a grinder that they are true, round and will run with less friction than those which are finished by other processes.

Where finish only is desired, grinding machines are economically used on connecting rods, cylinder heads, steam chest covers, pulleys, rolls, etc.

We are pleased at all times to answer inquiries concerning our machines and their operations and cordially invite all persons interested to visit our works and investigate our methods.

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No. 1 Universal Grinding Machine

Class of Work for which Different Machines are Adapted

Universal Machines

Nos. 1 and 1½ machines are used principally for finishing tools and a variety of parts such as usually come to the tool room or for small manufactured parts. Pieces up to 1¼ inch diameter, 12 inches long can be very nicely handled on these machines; particularly is this true where the number is not large and a great many changes have to be made. To use a machine of this kind continuously on parts of the size mentioned would, we think, be unwise, for the reason that the larger sizes of tools finish much more rapidly and their capacity make them more economical machines where large numbers of even what might be termed small parts have to be finished.

Nos. 2, 3 and 4 machines are also well adapted for finishing tools and a variety of parts. They are economical machines for manufacturing when used on parts up to 2½ inch diameter and not longer than 36 inches. Of course, larger pieces can be ground very nicely, but if quantities of these are to be finished a larger type of machine would show greater economy.

Nos. 7, 8 and 9 machines are adapted for the heavier class of work, and while they are frequently used for very large tools, they are principally used for the finishing of manufactured parts.

Plain Machines

Nos. 11 to 37 are distinctly manufacturing machines; they are adapted for grinding plain, straight and taper work, and all similar parts that can be revolved on two dead centers.

Gap Grinding Machines

These machines are provided with gap, which specially adapts them for finishing crank shafts, piston and valve rods, with pistons and yokes in place, or other similar parts having projections which

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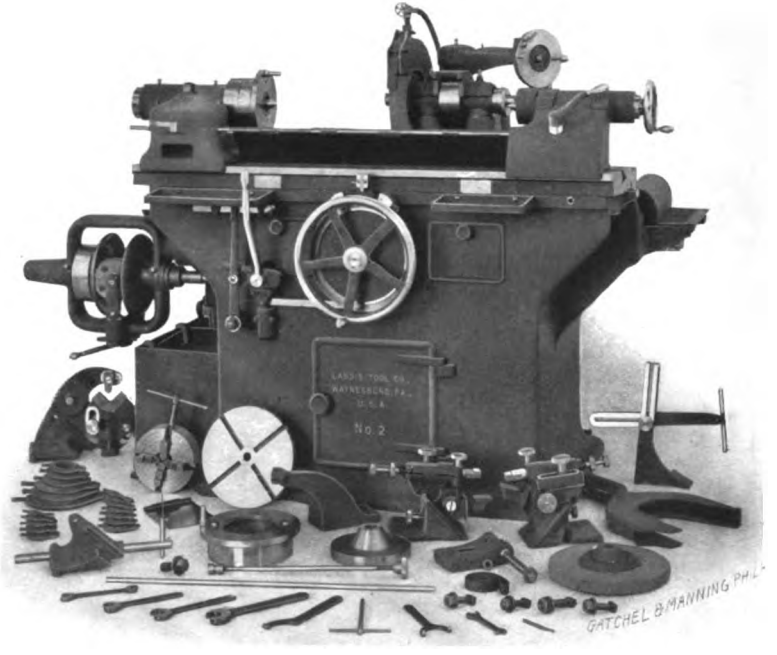

No. 2 Universal Grinding Machine

require a large swing, while the part to be finished is relatively small.

The gap can be located wherever desired, when ordered, to accommodate center crank shafts, extension rods, or other pieces having projections on any point of same. Crank pins and axles are also ground on these machines.

No provisions are made for grinding taper, but a cross slide adjustment of the foot stock is provided for aligning machine for straight grinding.

The grinding wheel and center is of special design, being offset for grinding close to piston heads and shoulders.

Crank Grinding Machines

These machines are designed specially for grinding crank shafts for gas and small steam engines, such as are used in the manufacture of automobiles, launches, etc.

The head and foot stocks are geared together, being arranged for driving the work from either end. For holding the cranks when grinding the wrists, adjustable work carrying heads are provided, which are attached to the face plates, holding the crank by the end journals as shown by Fig. 1, page 35.

For grinding the line journals the work is carried in the regular way by centers placed in the spindles of the head and foot stocks, for which operation the adjustable heads are quickly removed from the face plates and the centers placed in the spindles.

These heads are arranged with two independent rotary adjustments. One of these adjustments is for locating the crank shaft so as to give the correct throw to the cranks and the other consisting in an adjustment for the clamp which grasps the work, and is for obtaining the different relative crank positions. For example, if the cranks are spaced 120 degrees or 180 degrees apart, the second adjustment would be used to locate the different pins at these angles.

Fig. 2, page 36, shows a cross section and a front view of one of the adjustable heads. In the front view the circle of the largest diameter represents the periphery of the faceplate, and the slot in the upper part of the plate is for attaching the weights for counterbalancing the work. The Disk D which is mounted eccentrically upon the faceplate and is held to it by bolts in a circular

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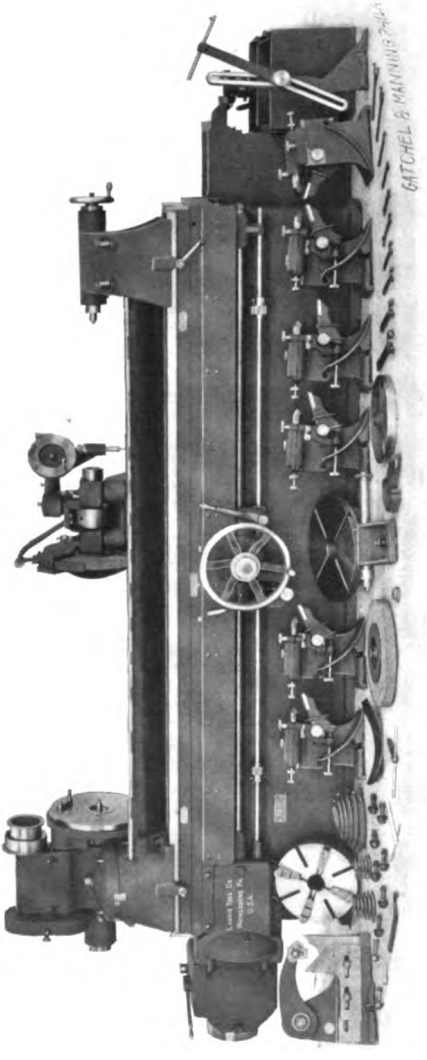

No. 8 Universal Grinding Machine

T-slot, may be swiveled to give the desired throw or eccentricity to the crank. The clamp C which grips the work is attached to a smaller disk E, which, with the stop pin used to locate this plate at the proper angle, is carried by a base or spider, bolted to the disk D. This smaller disk B, which carries the clamp, is eccentric with the large disk D. Graduations on the periphery of the large disk are made both in English and metric units and in swiveling it, the center of the shaft follows the circle E until it reaches a point which is the correct radial distance from the center of the faceplate of the grinder, when the disk D is clamped, holding it permanently in this position. The other adjustment, by which the small disk B and the clamp which it carries is rotated to the proper crank angle, is effected by the stop pin engaging notches in the edge of this disk.

Internal Grinding Machines

These machines are adapted for straight and taper internal grinding, a class of work for which they are specially designed. They are distinctly manufacturing machines and are suited for internal grinding such parts as milling cutters, reamers, bushings, dies, gauges, cones and a large variety of other parts requiring internal finishing.

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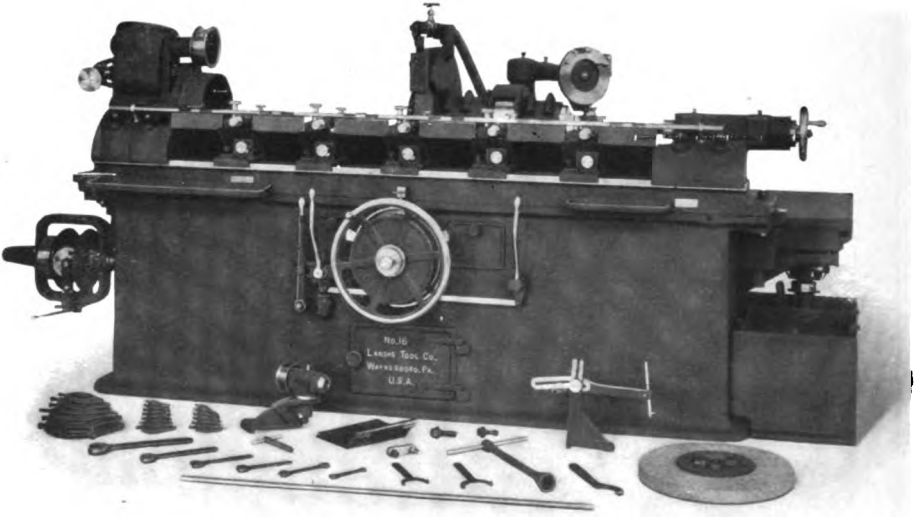


No. 16 Plain Grinding Machine

Care and Use of Grinding Machines

The durability and efficiency of any machine depends largely on the care which is given it. It must be kept clean, be well lubricated and carefully adjusted in order to give the best service. We recommend a good grade of mineral oil in preference to animal oil, as it does not gum so easily. Self-closing oil cups are provided at numerous places, and at others screw plugs are used with the word "Oil" stamped around the holes. Care should be taken that none are missed and that no grit is allowed to enter the bearings.

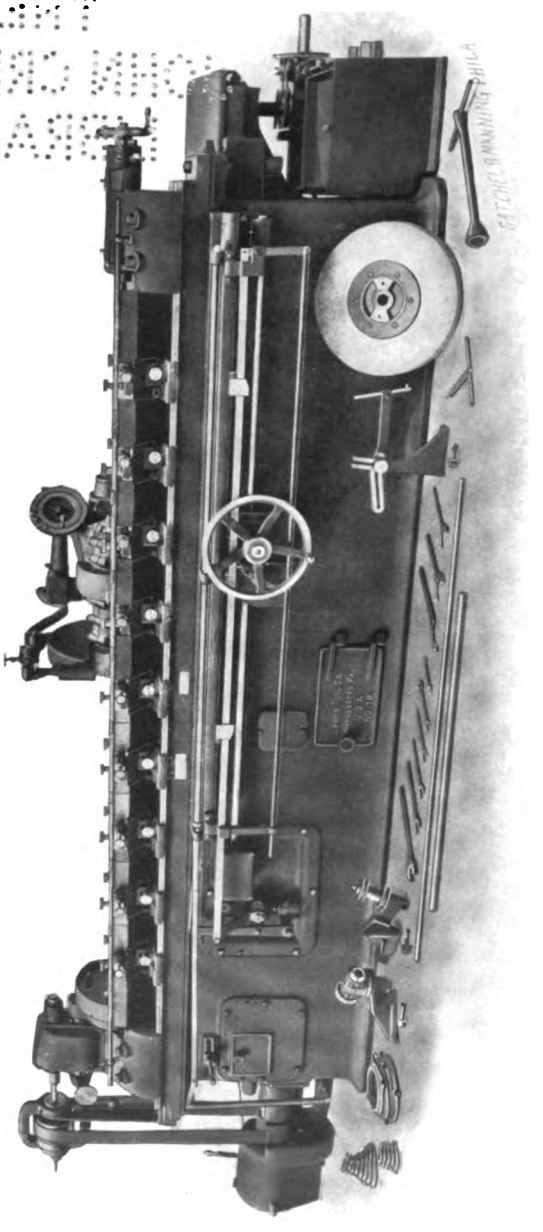
In erecting these machines they should be set level and on a solid foundation. The countershaft should be firmly secured and after being placed, the nuts holding the boxes should be loosened; then jar the boxes to allow them to assume a normal position and clamp the nuts. This is particularly important on such shafts as have three bearings so as to be certain there is no binding which will cause them to heat.

The belting used should be of a pliable nature and coupled so as to avoid a thick joint. On all sizes but the smallest we recommend a double belt. It is especially important that the belt driving the grinding wheel be smooth running and evenly coupled.

Adjustment of Boxes

In order to produce correct work, it is important that the spindle boxes are in proper adjustment, so that there is no lost motion. This is true of the head stock, foot stock, and grinding wheel spindles, for unless they are closely adjusted, even though the heads in which they are seated be heavy, good work may not result. Especially is this true of the wheel spindle boxes which, to do accurate work, should be adjusted closely, even though they warm up slightly.

Fig. 3 is a sectional view of the grinding wheel spindle and its bearings as used on universal machines. The spindle is hardened steel and the bearings are phosphor bronze, made adjustable for



No. 18 Plain Self-contained Grinding Machine

wear. The adjustment is made by slacking the tangent screws in the bronze boxes, drawing out the brass liner and scraping off surface of same sufficiently to take up the wear; then replace and draw up screws tightly. On Nos. 1, 1½, 2, 3 and 4 machines a fine lateral adjustment of the spindle, for grinding shoulders and the like, is provided. It is graduated to indicate .001 inch movement and the construction will be readily understood by referring to the figure named, this device is also illustrated in Fig. 15. A section of spindle and bearings on our Plain Grinding machines is shown in Fig. 4. These bearings are made of genuine babbitt metal solidly compressed and securely held in place. Adjustment of boxes is made by the removal of thin liners.

Adjustment of Cross Slide

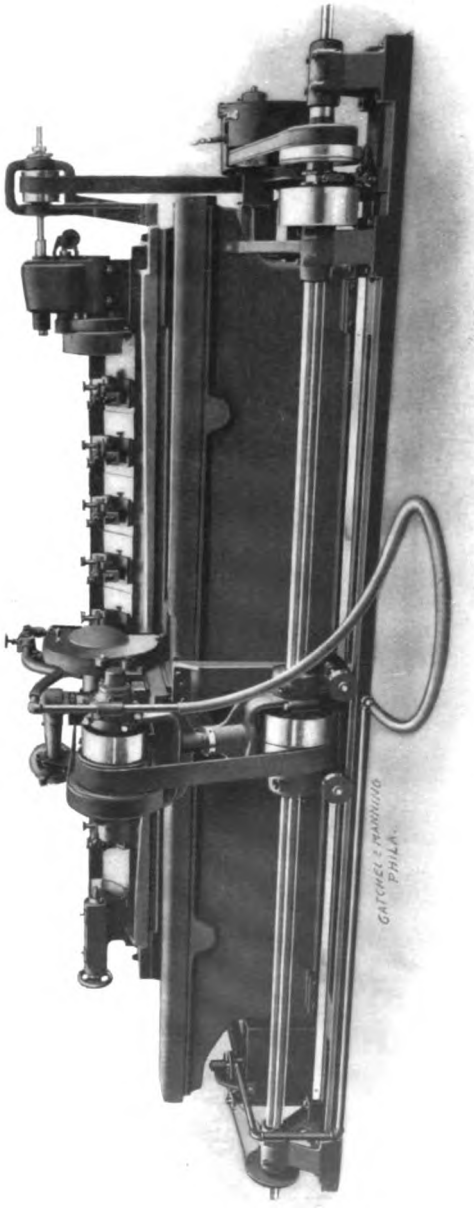
The adjustment of the grinding wheel slider is equally important and should be close, yet not tight enough to cause it to move hard. The manner of adjusting will be clear to anyone. The slide should be well oiled through the holes provided.

Graduations

Graduations to assist in setting the machine for grinding tapers and cones are provided at three places. When the headstock is set for grinding shafts, it is doweled in position, but for setting to grind tapers or cones held in a chunk or on a face plate and for grinding centers as well as to gride sides of saws, cutters and plates, the graduations should be used. The different operations for which the head stock graduations are useful are shown in Figs. 14, 16, 17 and 18. The reading is in degrees.

Table Graduations. The table for head and foot stock swivels on a central stud and is graduated on the end by which it can be set to grind tapers as shown in Figs. 11 and 12. There are two graduations on the same end of the table, one reading ¼ degrees and the other ⅛ inch per foot; the degrees reading from the center line of the work and the inches reading for the whole taper. See Fig. 8.

Table adjusting screw is shown in Fig. 8, by which accuracy of setting is attained for either straight or taper work. To set the table to a graduation mark and have it grind an exactly



No. 18 Plain Self-contained Grinding Machine. Rear View

straight shaft or an exact taper is improbable, since a very slight error in setting, not visible to the eye, will show upon the work, and this inaccuracy will be double the error in setting. Graduations give only a very close setting. It will be so near, however, that there will be no danger of spoiling the work (unless there were insufficient allowance for grinding) by the first trial, when the error occurring must be corrected by the screw. It will be noticed by reference to Fig. 8 that the nut on the adjusting screw is coupled to the table by a pin (on all machines except the large sizes.) When wanting greater taper than the screw will permit, this pin can be withdrawn, but the setting must then be done by hand. The swivels of head stock and wheel slide (universal machines) are set by graduation, and for correct setting must be adjusted in the ordinary manner where no screw for the purpose is used.

Graduations on Wheel Slide. The graduations on wheel slide of universal machines are used to set to greater angles than can be ground by the automatic traverse. This enables the grinding of two tapers at one setting, as shown in Fig. 10.

Grinding Wheels

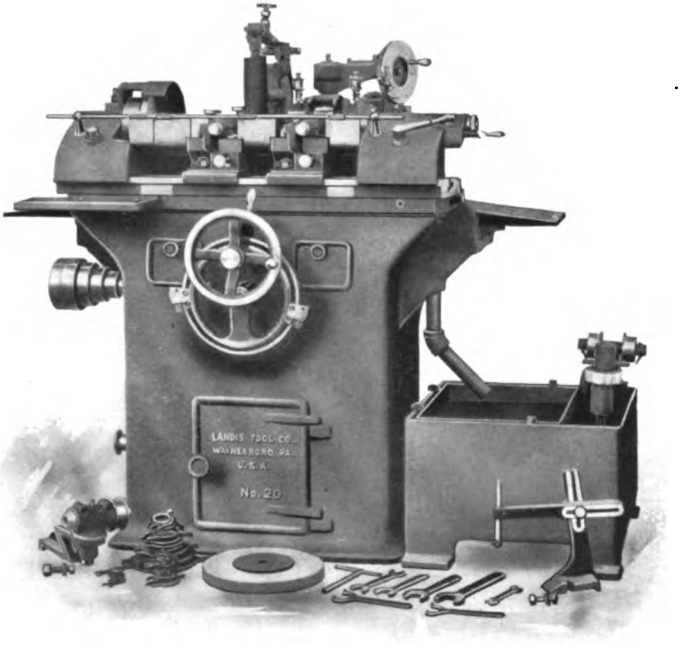
In furnishing grinding wheels with our machines we include such as we think will be the best suited for general service. We have found corundum to be a much better abrasive than emery and recommend its use for the large majority of finishing. Emery, which is impure corundum, will however, give the higher polish.

Most manufacturers of wheels recommend their medium grade, that is the grade about midway between the hardest and the softest, Grade M. In our experience one degree softer than this grade gives the best all around results.

For parts that are heavy and rigid, a harder wheel may be used, while for more delicate parts, such as pipe rolls or slender shafts, a softer wheel will be found better.

The question as to what is the very best wheel for finishing any particular piece, cannot be definitely answered. We have made exhaustive tests, and in submitting the following, are of the opinion that the wheels recommended will be found suitable for the purpose stated.

As there is such a variety of grading lists used by the manufacturers of wheels, we use the medium grade as a basis.



No. 20 Plain Grinding Machine

	Material.	Grit No.	Grade.
Soft Steel.	Ordinary shafts.	24 to 60	Medium.
	Steel tubing or very light shafts.	24 to 60	Two or three grades softer than Medium.
Hard Steel and Cast Iron.		24 to 60	Medium or one grade softer.
Internal Grinding.		30 to 60	Medium to several grades softer.

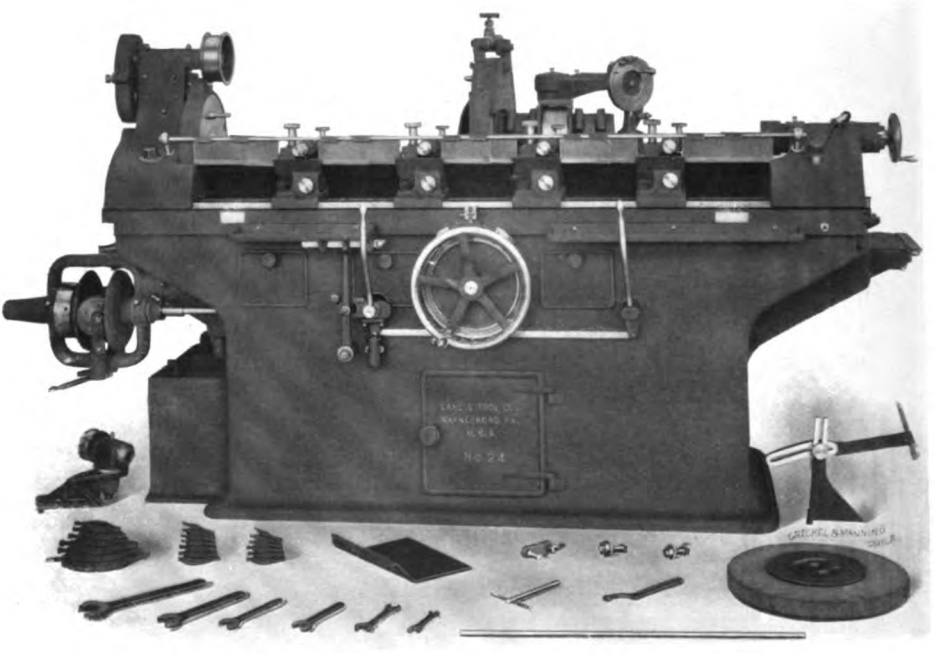
In making the above list we have mentioned wheels as coarse as we think proper and as fine as is necessary for ordinary finishing.

Grit No. 24 may be too coarse for any but the rougher character of work, but if mixed with No. 36 it gives fair results. Grit No. 30 used separately is capable of a very fair commercial finish, but if mixed with 46 will give as fine finish as is desired by the majority of grinding machine users and at the same time retains the rapid cutting qualities. Nos. 46 and 60 are as fine as is necessary for almost any manufactures, although finer than these are used by some concerns who require very high gloss.

For grinding hardened steel and cast-iron wheels made by what is known as the silicate process give very good results, but the vitrified wheel in our experience is the better for general use.

The particular advantage of silicate wheels is that they are extremely free cutting and in grinding hardened steel will remove stock rapidly with the least possibility of burning, and consequently drawing the temper. While they will produce a good commercial finish, vitrified wheels are to be preferred when an extremely fine finish is required.

A satisfactory grinding wheel is an important factor in the production of good work. Too much, however, must not be expected of one wheel. In machine grinding, it is desirable in order that the cut may be constant and give the least possible pressure and heat, to break away by the act of grinding, the particles of the wheel after they become dulled. It is this faculty of yielding to or resisting the breaking out of the particles called the **grade.**



No. 24 Plain Grinding Machine

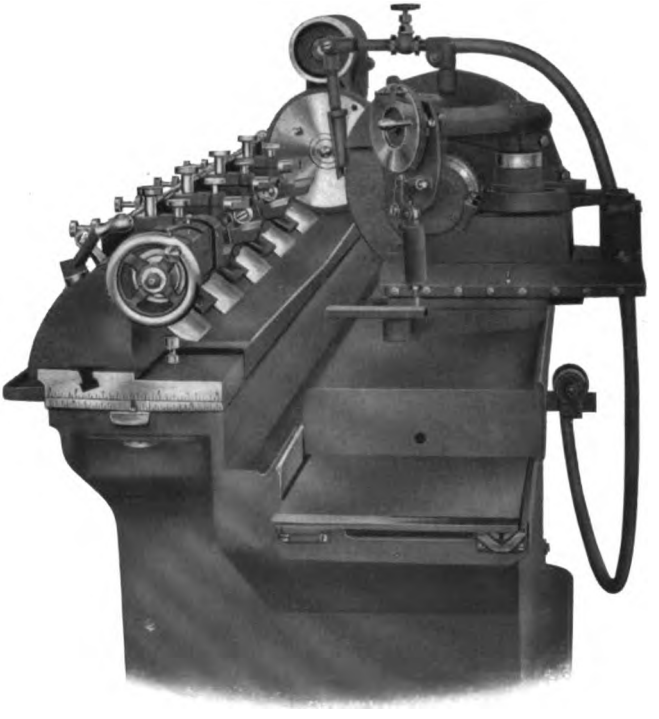
The wheel from which the particles can be easily broken is called soft and the one that retains its particles longer is called hard. It is evident that the longer the particles are retained the more dulled they will become and the more pressure will be required to make the wheel cut. Retaining the particles too long causes what is familiarly known as glazing.

A soft wheel is less apt to change the temperature of the work or to become glazed than a hard one. It is best for grinding hard steel, cast iron, brass, copper and rubber, while a harder and more compact wheel is better for grinding soft steel than wrought iron. As a rule, the harder the stock the softer the wheel required to produce a given result.

A wheel for machine grinding must cut without pressure, to effect which it must always be sharp. This is maintained by the breaking out of the particles, therefore a wheel of proper grade to cut at a given work speed possesses "sizing power" or the ability to size uniformly without breaking away its own particles too rapidly; obviously if the work is revolved at a higher speed the particles will be torn away too fast and the wheel will loose its "sizing power." It will thus be seen that the work speed should always bear a proper relation to the cut of the wheel, regardless of the diameter of the work.

Care of Emery Wheels

Chattering and waviness in appearance of the part finished is usually caused either by the grinding wheel spindle being loose in its bearings, the grinding wheel out of true or out of balance, or particles of the material being ground become imbedded in the wheel. A loose spindle should, of course, be adjusted. In great majority of cases, however, the cause of imperfect work is due to the wheel getting out of shape. It is important that the face of the wheel should be perfectly parallel with the travel of the carriage, and in order to produce a result of this kind a diamond tool must be used, as near to the foot stock center as is practicable, especially on work of small diameter. Where the work is not so small, say 2-inch diameter, the truing device can be clamped at the most convenient point, and in either case it should be carefully seen to that the stud holding the diamond and the



End View of No. 24 Plain Grinding Machine showing stationary back rests in place

arm supporting same, are solidly against the work. If the truing device is not rigid the grinding wheel will not be true.

It will be observed that the stud in which the diamond is mounted can be revolved in its holder, and it is important that the diamond point presented to the wheel should be sharp; for instance, if the diamond should become worn and flattened, it should be turned and thus present a new point to the wheel. Keeping the wheel true is one of the important points for the operator to observe, particularly so when he comes to making a final finish. The wheel should be traversed by the diamond at a uniform speed, rather slowly in order to give the diamond time to cut awy the particles. If it is desired to do rapid cutting, it will be found proper to pass the wheel by the diamond faster, thus making a rougher face on the wheel.

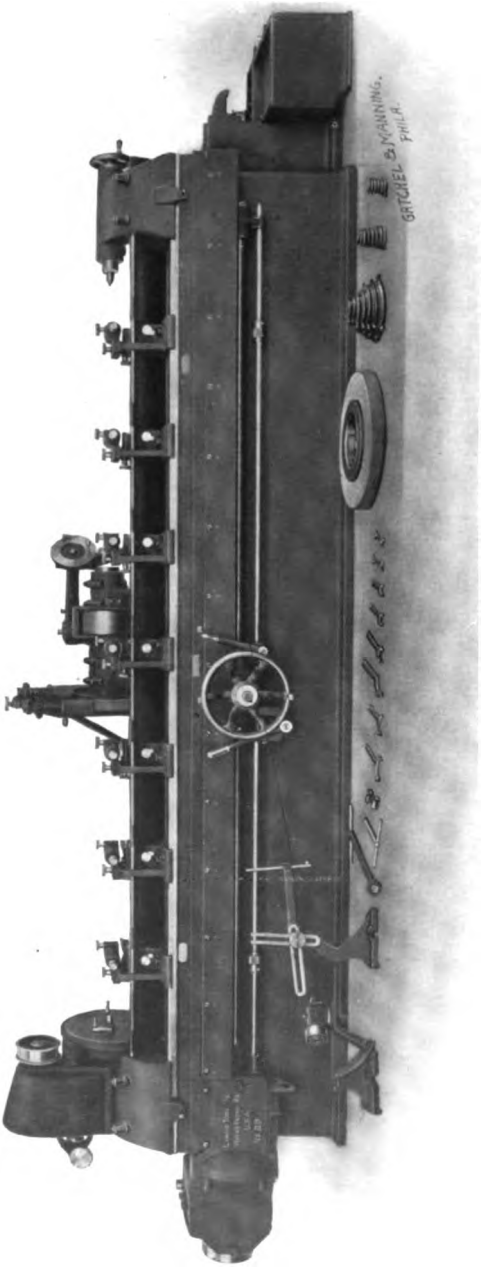
The number of times that the face of a grinding wheel has to be dressed off depends entirely on the character of the work being finished and the kind of wheel used. There are some wheels that wear away fast enough so that little truing is necessary; there are also cases where a harder wheel is desirable and a hard wheel necessarily requires more dressing than a soft one. Where pieces are rather large and considerable stock has to be removed, it will be necessary to true the wheel each time a piece receives its finishing cut.

On small pieces having .008-inch or more to remove, it is more desirable to rough off all the pieces to within about .002-inch of the finished size before attempting to finish any of them. In this way less care has to be given to dressing off the wheel, as in roughing very little attention need be paid to the wheel, and in finishing one dressing will be sufficient for a number of pieces.

As stated above, it is desirable generally to present a sharp point to the wheel in dressing same, but there are times when the smooth surface is preferable, particularly when it comes to producing a very fine finish; the flat surface of the diamond will tend somewhat to glaze the wheel and thus produce a better finish. A coarse wheel properly dressed will always produce a very nice finish.

Work Not Round

One cause of this may be that something has gotten into the centers, or that the centers are not true and may be loose. If the



No. 29 Plain Grinding Machine

centers of machine are ground up nicely and the centers in the work are true, no difficulty will be experienced. In the grinding of long shafts it is sometimes found that they get out of shape due to their own internal strains. The piece should be supported by the spring rest, which allows it to center itself and finally becomes a perfect cylinder. The rests are also so arranged that they may be clamped solidly, when desired. One rest should be used for each one foot of length on shaft 1-inch diameter, and for smaller shafts a greater number should be used.

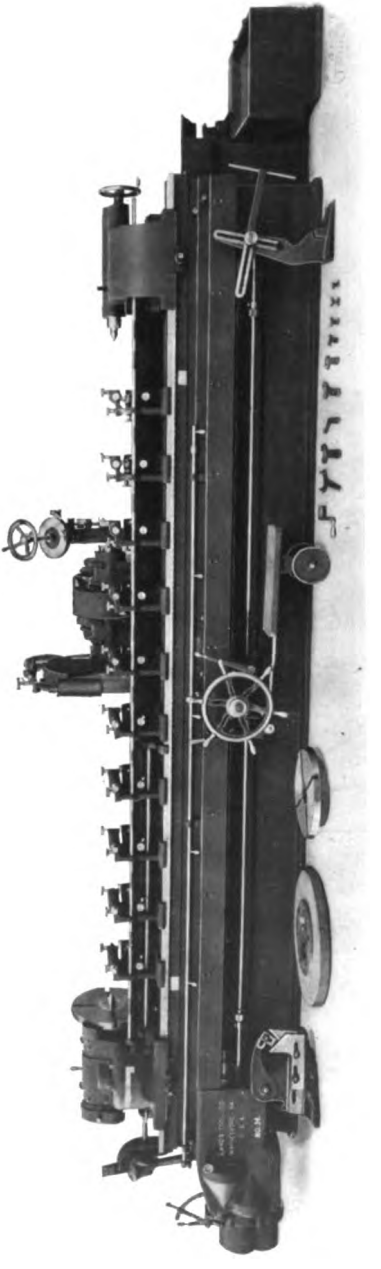
Water

For all grinding operations, except possibly internal grinding where it is often inconvenient, a good supply of water should be used. It keeps the wheel clean and free cutting and prevents the generation of heat, which causes the work to get out of true. We prefer hydrant water, although we regularly supply pumps with our machines; we do this because many concerns find it undesirable to use city pressure. If the pump is used, water in which a little sal-soda has been dissolved will prevent the rusting of the work, but this is the only advantage that a pump has over hydrant service. The pumping around of the water accumulates a filth which has to be removed every day or two in order to get good results.

Speed

The proper surface speed of the work varies somewhat on the material or shape to be finished; from 15 to 30 feet would be a good range, although for cast iron the speed can be slightly increased. The more delicate the work the slower it should turn.

The traverse speed of grinding wheels should be about three-fourths of the width of wheel used; that is, the grinding wheel should travel about one-half to three-fourths the width of its face to each revolution of the work. There are times when a slower traverse is desirable, and this is often necessary when giving a final finish to the piece. Peripheral speed of the grinding wheel should be approximately from 5,000 to 5,500 feet per minute; there are times possibly when ths wheel might turn more rapidly, but with high speed there is danger of the wheel breaking.



No. 34 Self-contained Grinding Machine

Feeds

The size and character of the work to be finished will determine the depth of cut that should be made at each reversal of the grinding wheel. Where the part to be finished is rigid enough to stand a heavy cut, the wheel should be forced into the work until the belts are doing the utmost, when the feed should be relieved slightly. This, of course, applies to hand feeding the wheel. When the automatic feed is used a sufficient movement should be applied at each reversal to keep the wheel working to its maximum, and yet not be forced so hard as to get it out of shape. It is often found when taking a rather heavy cut that the wheel does not get out of shape any more quickly than when a light cut is taken.

In cases where the wheel cuts first on one side of the work and then on the other, it is not the fault of the machine, but may be caused by an insufficient amount of water being used or the material may have been strained and equalizes itself when the surface is removed. The grinding machine detects its own errors. A slight difference in sparks indicates to the ordinary mind that the work is much out of shape; in many cases it may only be one quarter thousandth and sometimes as little as one-tenth of thousandth or even less. To overcome this imperfection the wheel should be kept sharp and fed one quarter thousandth at each reversal until the work runs true.

Internal Grinding

In grinding out a hole in the end of a shaft it is held in a chuck and supported in the center rest as shown in Fig. 12. The internal grinding fixture for this work is secured on the rear of the wheel base, after removing the grinding wheel case, then removing the grinding wheel and replacing with the driving pulley to which the internal fixture is belted. The grinding wheel base is then loosened and turned end for end, which brings the fixture in correct position, and it is again secured for grinding. This change crosses the vertical belt and reverses the motion of the grinding wheel with relation to the work, which is correct for internal grinding. The motion of surface of work and wheel should always be reverse to each other; therefore in external grinding the wheel and the

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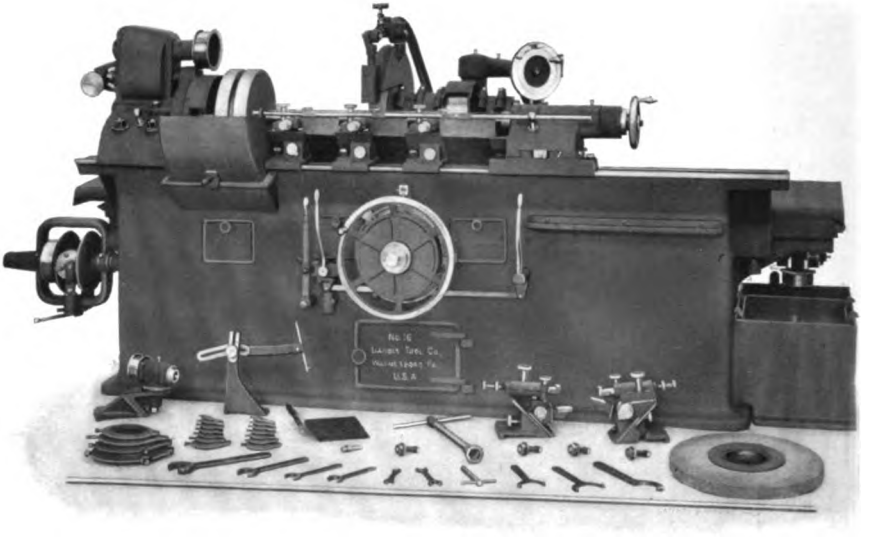

No. 16 Gap Grinding Machine

work revolve in the same dirction, and for internal grinding they revolve in opposite directions. To grind holes in work which can be held in the chuck or on a face plate without the rest the plan will be obvious.

In internal grinding it is important that the part should be as nearly finished when they come to the grinder as possible. Internal grinding is a much slower operation than external grinding, on account of lack of rigidity in the grinding wheel spindle and also on account of the small size of wheel that must be used.

In order to be certain that the machine is setting perfectly straight, and that the hole to be finished will have parallel sides, it is desirable, while the machine is setting for external grinding, to insert in the chuck, a pin or shaft about 1¼-inch diameter and slightly longer than the hole to be ground and grind it perfectly straight; then after putting in place the internal fixture, remove the piece ground and place the bushing or whatever in the chuck, and one can rely on the hole being parallel same as the external surface which was finished before the internal grinding was commenced.

Preparing Parts to be Ground

To obtain the highest degree of economy with grinding machines, it is important that all processes of finishing should be considered. Some years ago the practice of allowing from .005-inch to .008-inch to grind off was considered proper, and the machines then obtainable really saved concerns desiring accuracy some money on their finishing. With our present type of grinding machines less care is necessary in preparing the pieces to be ground, and, as would naturally follow, greater economy is secured. Assuming that the piece to be finished is, in the rough, from $\frac{1}{16}$-inch to $\frac{3}{16}$-inch above the finished size, all that is necessary is to take one rough cut on a lathe, approaching as nearly as possible the finished size; in most cases it will be found that the piece is from .010-inch to .035-inch larger than it should be when finished. From this point it is more economical to grind than it would be to take a second cut on the lathe. We do not claim that as much as ⅛-inch can be ground off economically. With the present high speed steel it is cheaper to turn off one cut and then grind. There are, however, some cases in which as much as ⅛-inch

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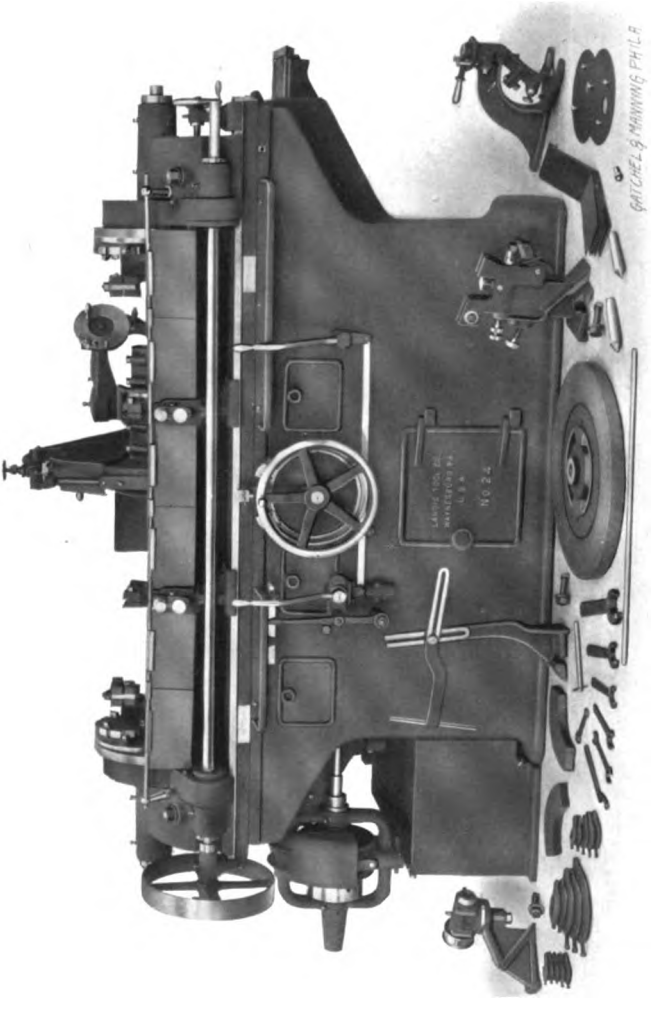

No. 24 Crank Grinding Machine

can be economically ground off, but generally cast iron will be found the material on which a saving can be effected when this amount of reduction is to be effected.

Another feature in favor of the grinder is that in taking a rough cut on a lathe, less skill is required, and naturally more rapid execution is secured. In finishing on a grinder, the same argument applies, as every part of the machine is graduated and the correct size very easy to secure. As an example of what we mean, on the Nos. 2, 3 and 3 machines, to reduce the diameter of the shaft .001-inch, it is necessary for the operator to turn the periphery of grinding wheel feed up hand wheel from $\frac{3}{16}$-inch to $\frac{1}{4}$-inch.

It should be the intention always to carry the work being ground on two dead centers; there are of course times when this is not possible, but wherever practicable, no revolving of centers should be used. On the plain machines both centers remain stationary, and nothing but parts having center at each end can be finished; unless, as the case may be, it would be desirable to run the part in bearings. Many times this is desirable, and enables the turning out of work more rapidly than could be otherwise secured.

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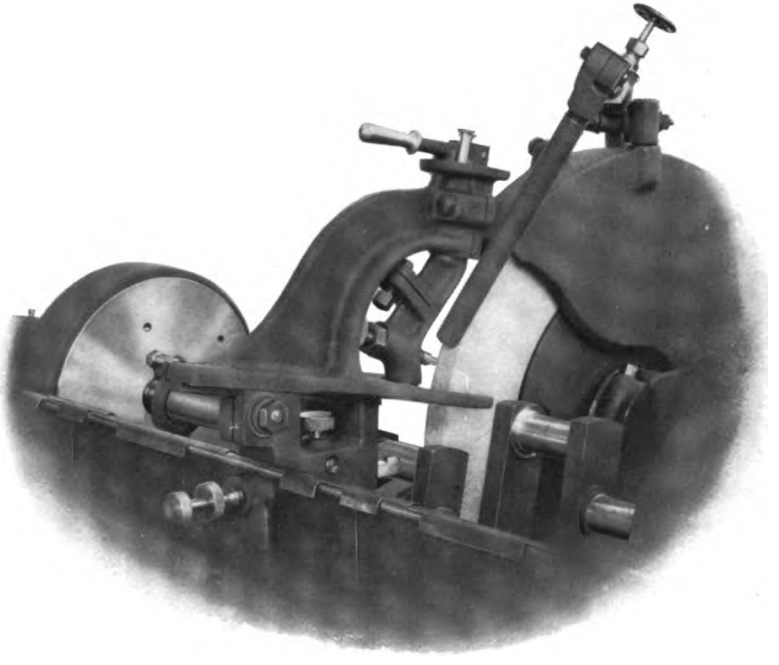


Crank Grinder—Combination Grinding Wheel Truing Device, arranged for truing face of the wheel and also for forming corners to an exact radius for grinding fillets

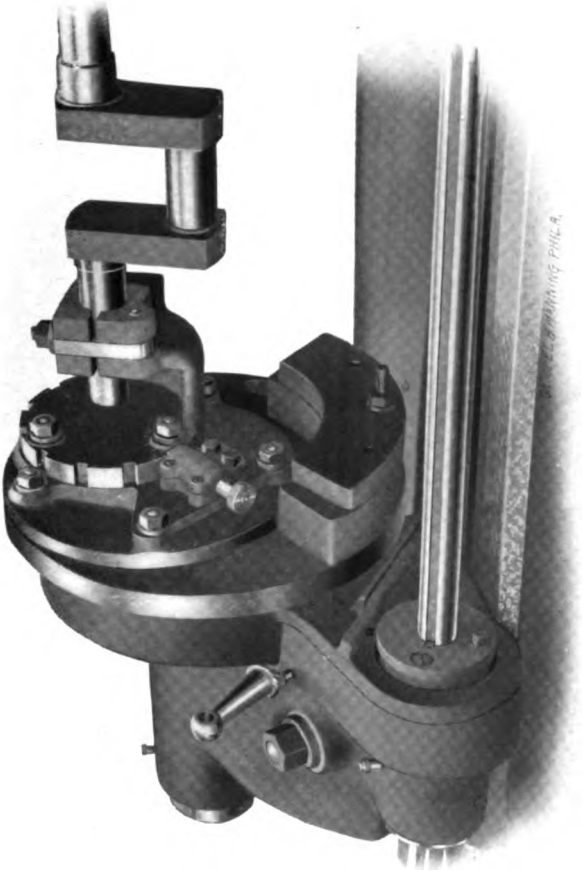


Fig. 1. Crank Grinder Adjustable Work Carrying Head, showing method of holding cranks when grinding the wrists. For general description see pages 9 and 11, cut Fig. 1, page 33.

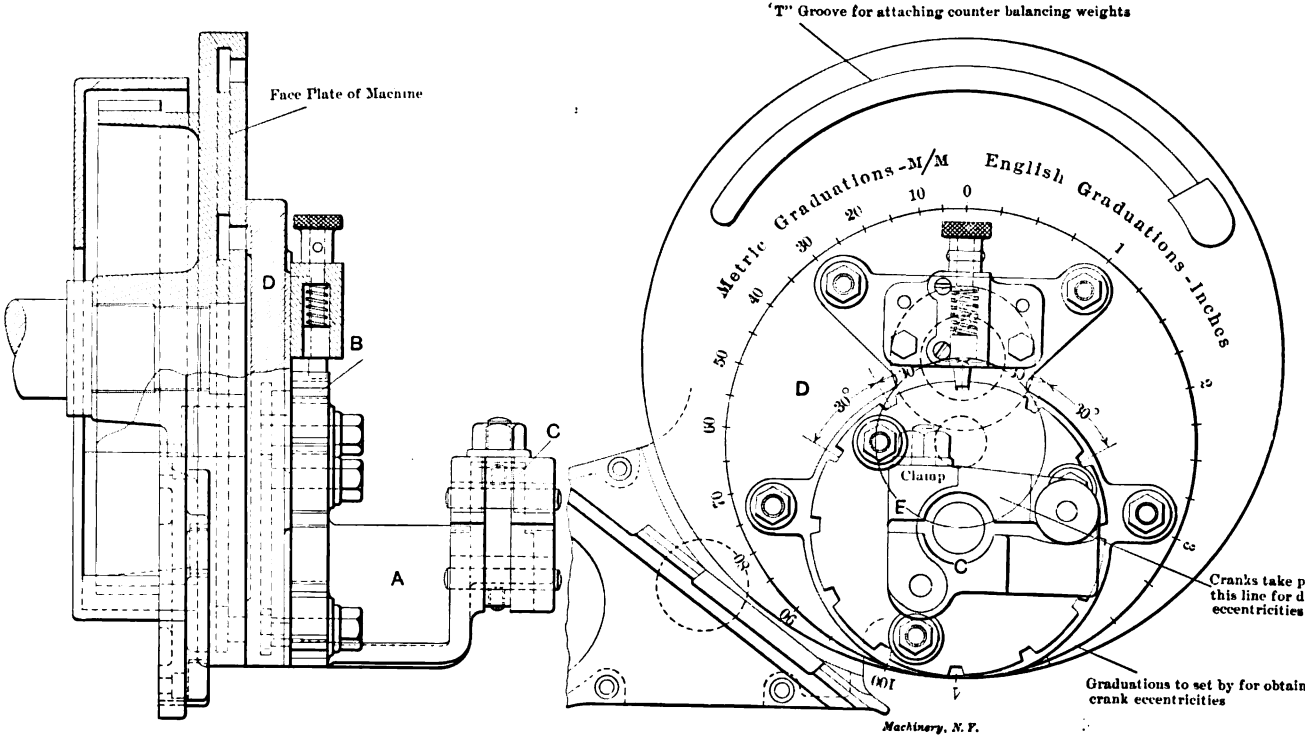
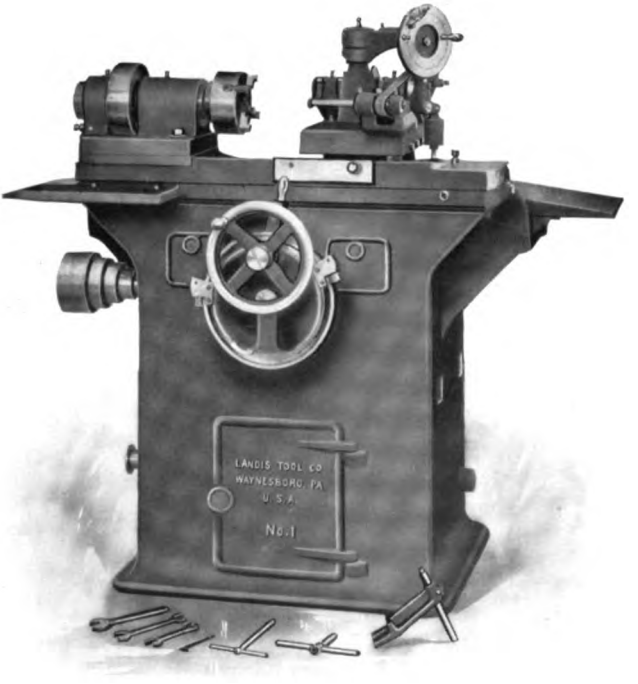


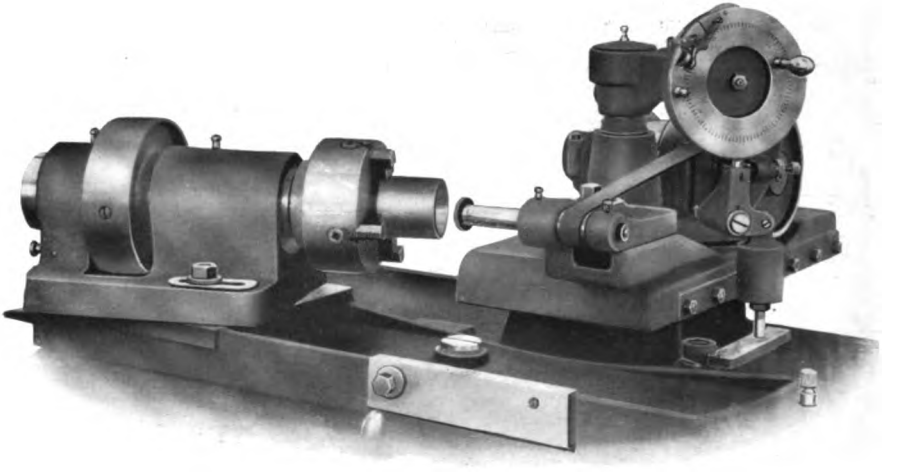
Fig. 2. Crank Grinder Adjustable Work Carrying Heads

Landis Tool Company



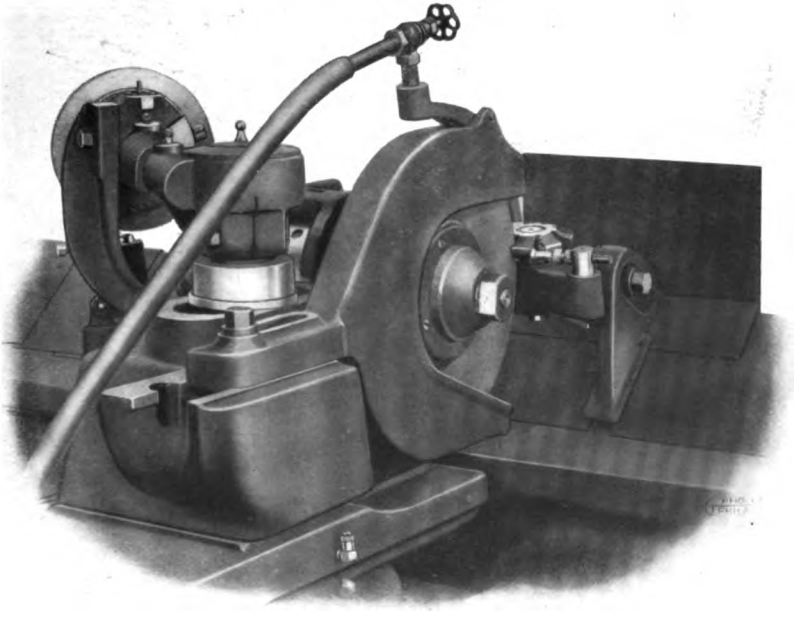
No. 1 Internal Grinding Machine

Landis Tool Company

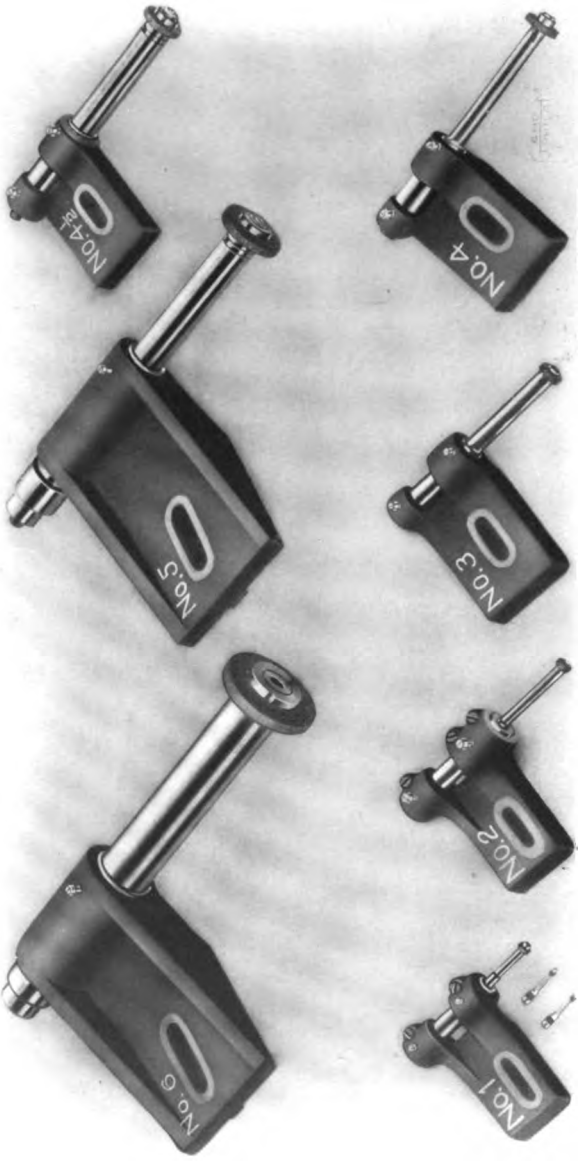


Internal Grinding Machine. Set for operation of taper grinding

Radial Grinding Wheel Truing Device. For forming corners of wheel for grinding fillets.



Gear Cutter Grinding Attachment



Standard Internal Grinding Fixtures

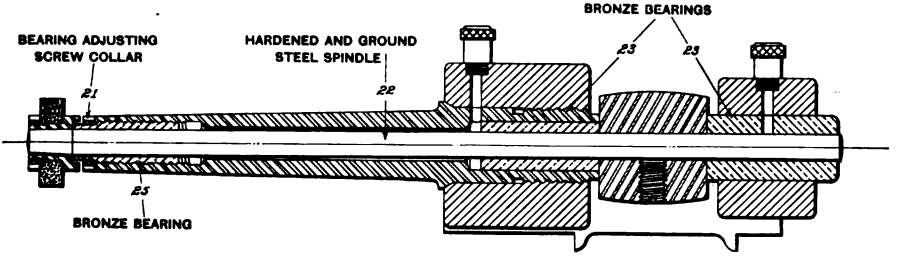
Internal Grinding Fixtures

The cut in the opposite page illustrates the entire line of standard Internal Grinding Fixtures used on our different machines.

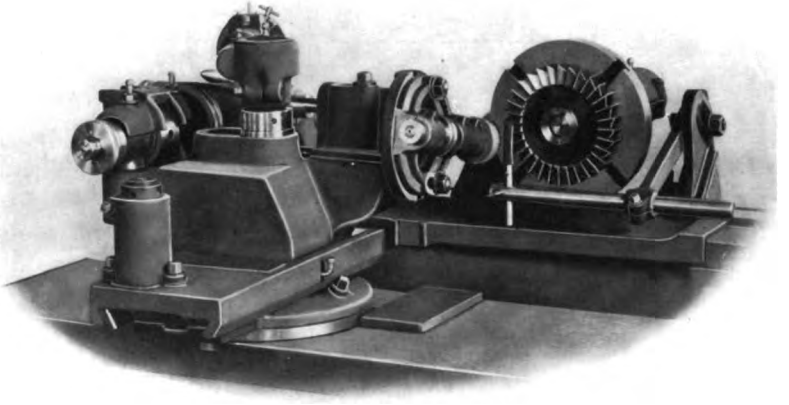
While these fixtures cover a wide range of work, quite frequently customers require them to have spindles of special sizes to suit conditions of their particular work. In this case we are prepared to furnish the special sizes on short notice.

List of Standard Fixtures

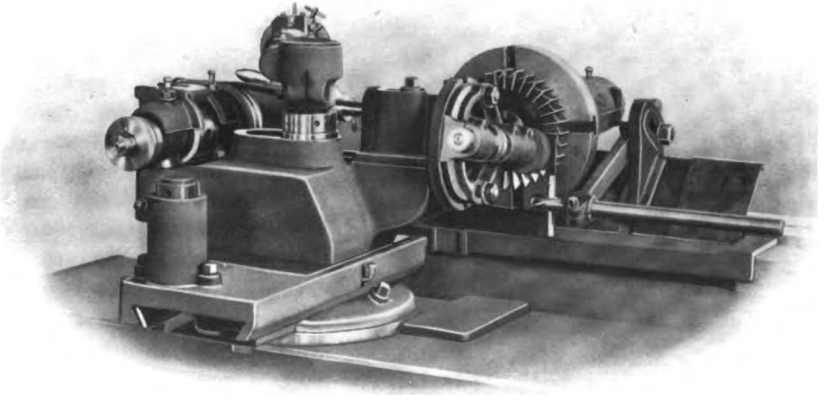
No. Fixture	No. Machine Where Used	Diameter Will Grind	Length Will Grind
1	1, 1½, 2, 3, 4	¼ inch and upward	1½ inch
2	1, 1½, 2, 3, 4	½ " " "	3¼ "
3	1, 1½, 2, 3, 4	¾ " " "	4¼ "
4	1, 1½, 2, 3, 4, 7, 8, 9	1 " " "	5½ "
4½	1, 1½, 2, 3, 4, 7, 8, 9	1½ " " "	6½ "
5	1, 1½, 2, 3, 4, 7, 8, 9	2 " " "	8 "
6	2, 3, 4, 7, 8, 9	3½ " " "	12 "



Section through Internal Grinding Fixture Spindle and Bearings

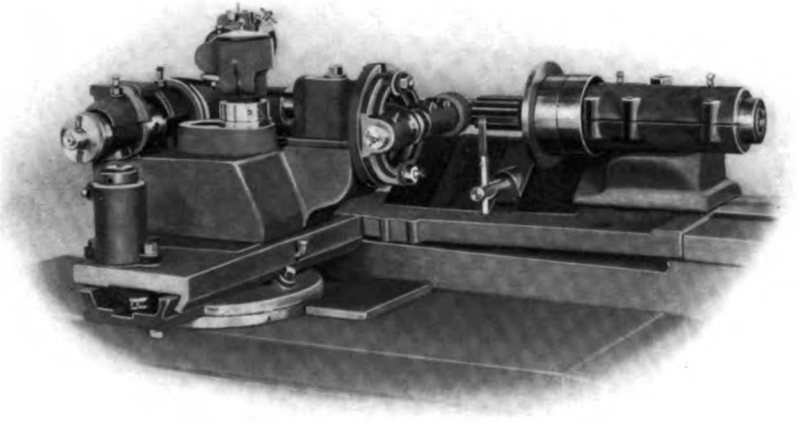


Grinding Side Teeth of Milling Cutter. Right hand operation

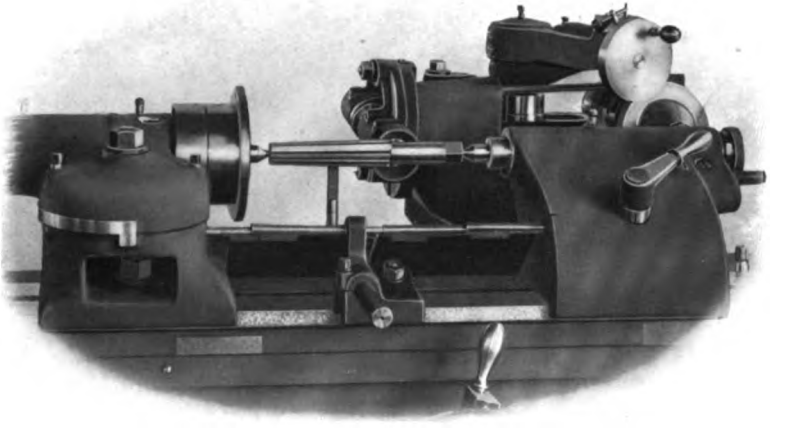


Grinding Side Teeth of Milling Cutter. Left hand operation

SIDE MILL GRINDING ATTACHMENT FOR UNIVERSAL MACHINES

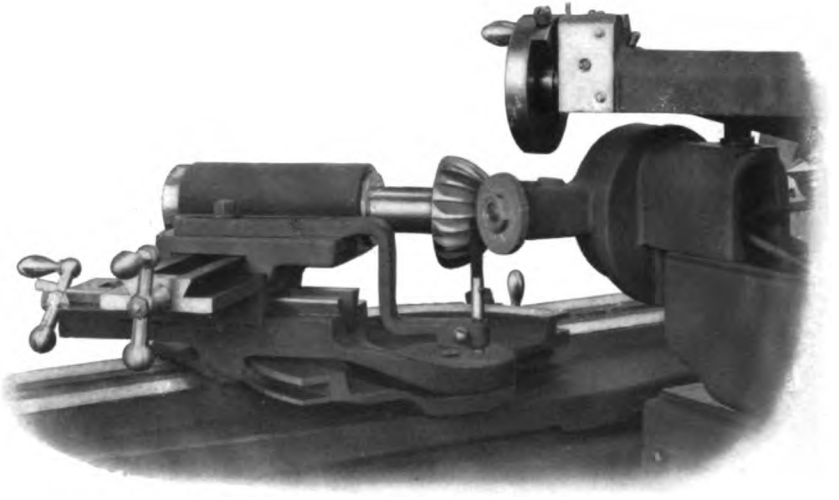


Backing Off Machine Work

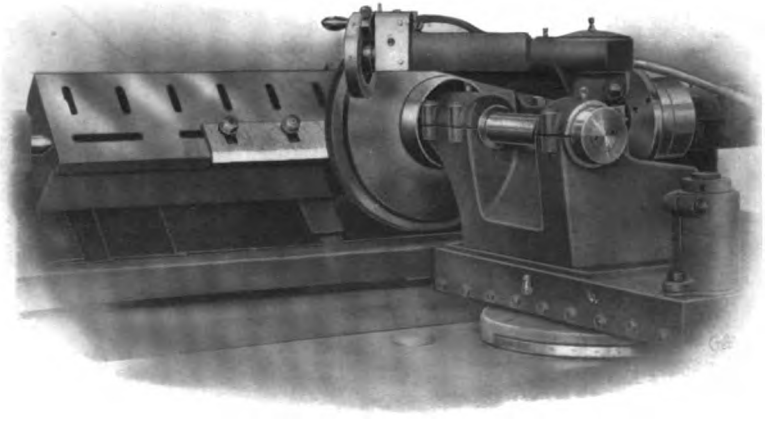


Backing Off Taper Reamer

SIDE MILL GRINDING ATTACHMENT FOR UNIVERSAL MACHINES

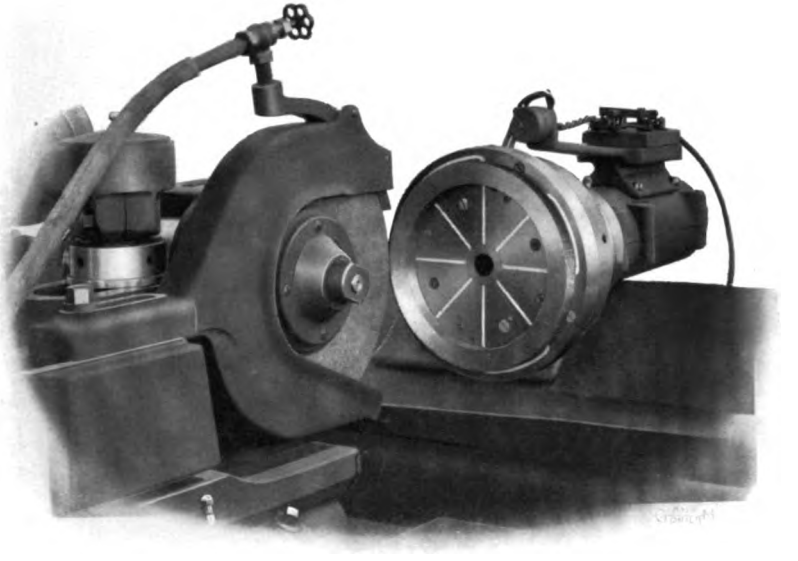


Spherical, Concave and Convex Cutter Grinding Attachment

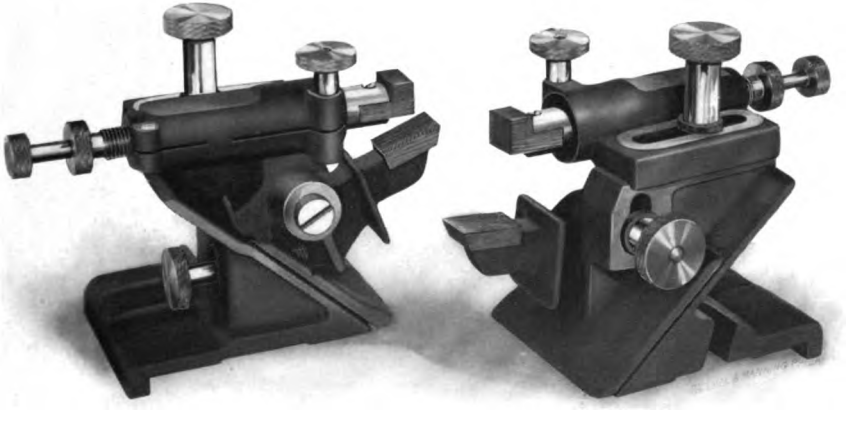


Plain Surface Grinding Attachment

ATTACHMENTS FOR NOS. 2, 3 AND 4 UNIVERSAL MACHINES



Magnetic Check for use on Universal Machines



Style of Stationary Back Rests used on all Universal and Plain Machines

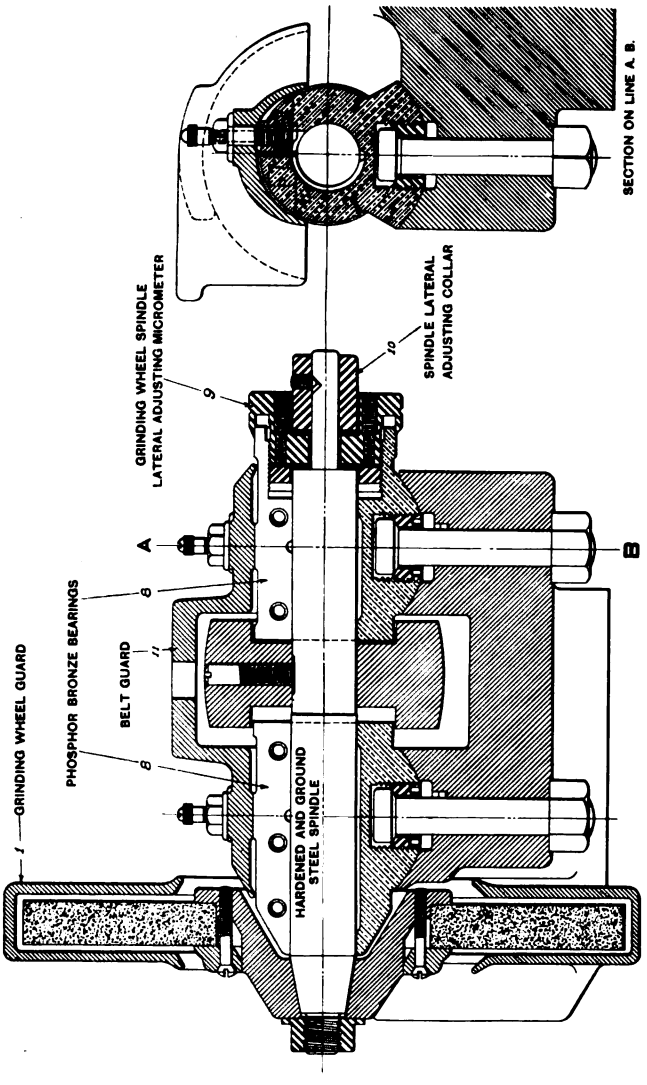


Fig. 3. Section Through Grinding Wheel Spindle and Bearings—Universal Machines

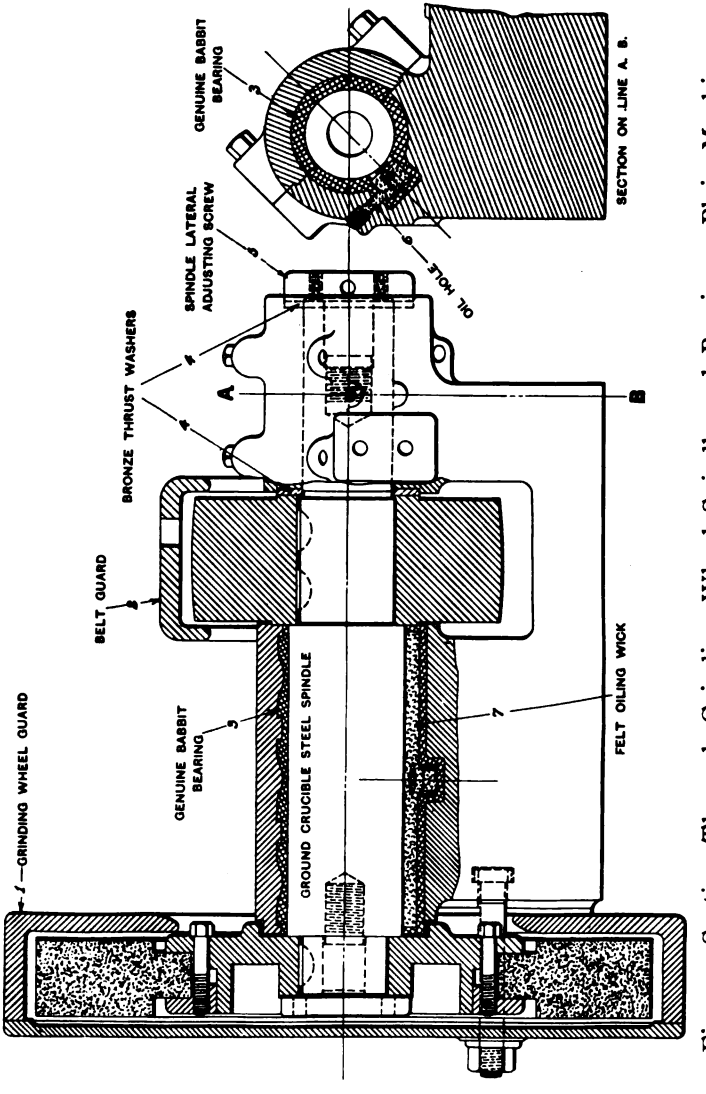


Fig. 4. Section Through Grinding Wheel Spindle and Bearings—Plain Machines

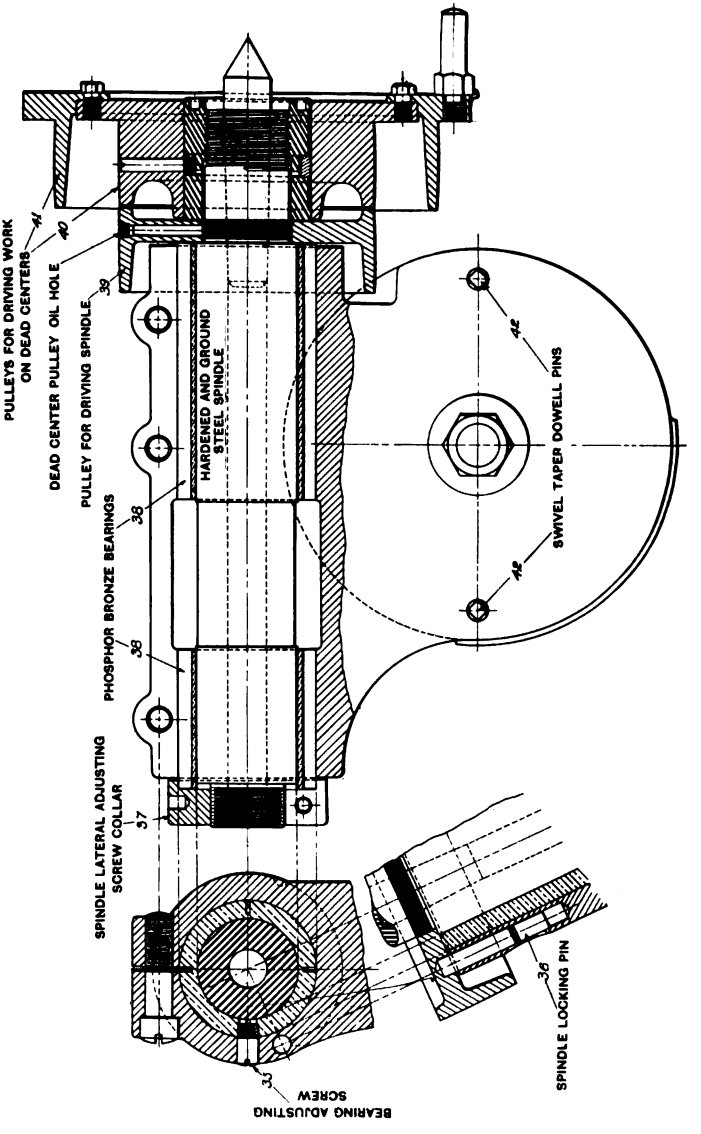


Fig. 5. Section Through Headstock Spindle and Bearings—Small and Medium Size Universal Machines

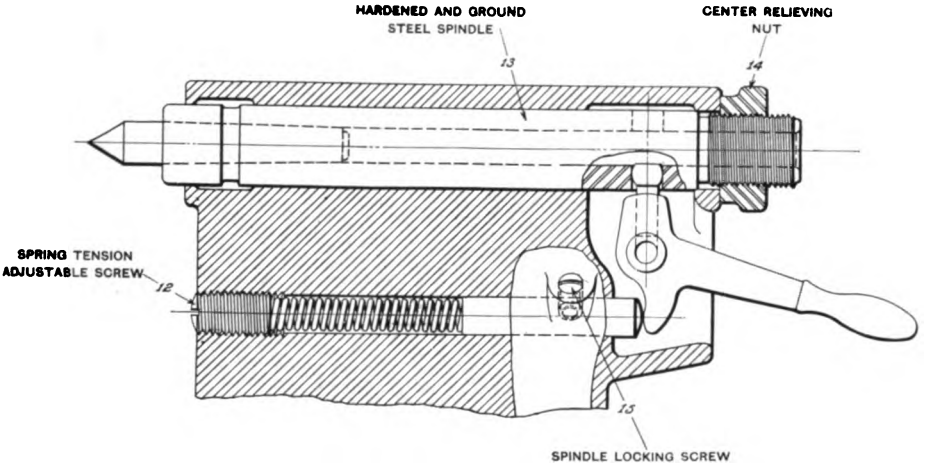


Fig. 6. Section Through Footstock Spindle—Small Universal and Plain Machines

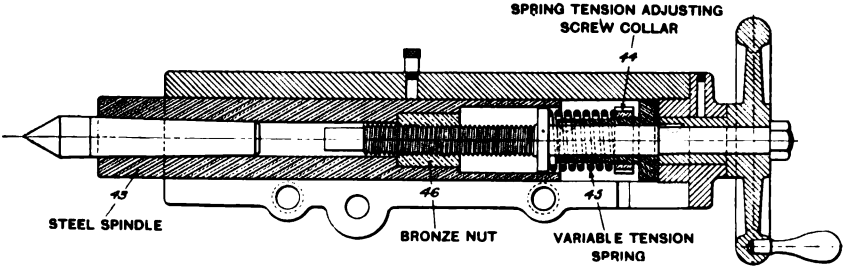


Fig. 7. Section Through Footstock, Medium and Large Universal and Plain Machines except Nos. 31 to 37

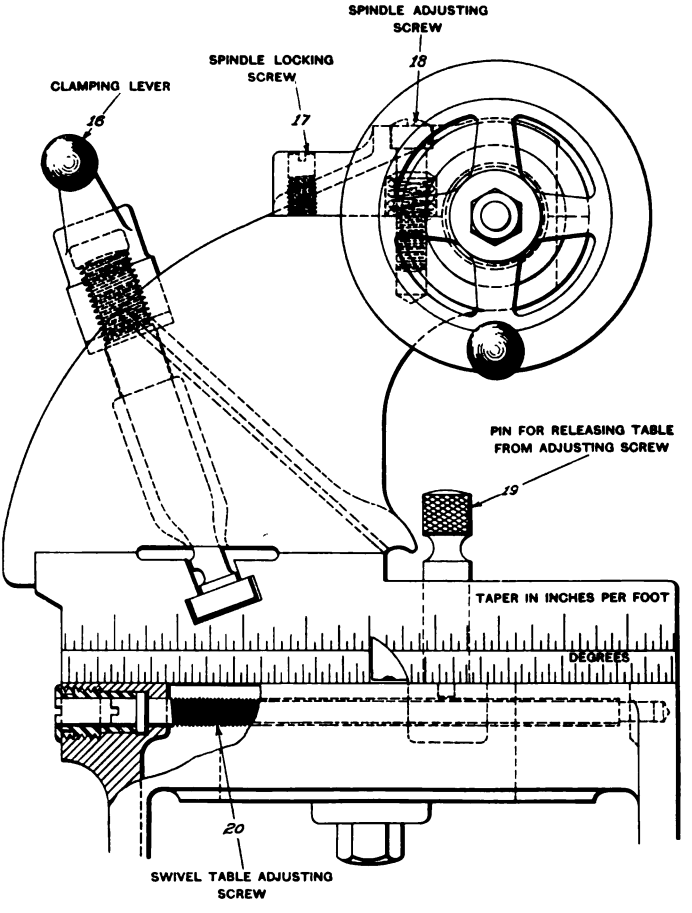


Fig. 8. End View Footstock and Table—Small and Medium Size Universal and Plain Machines

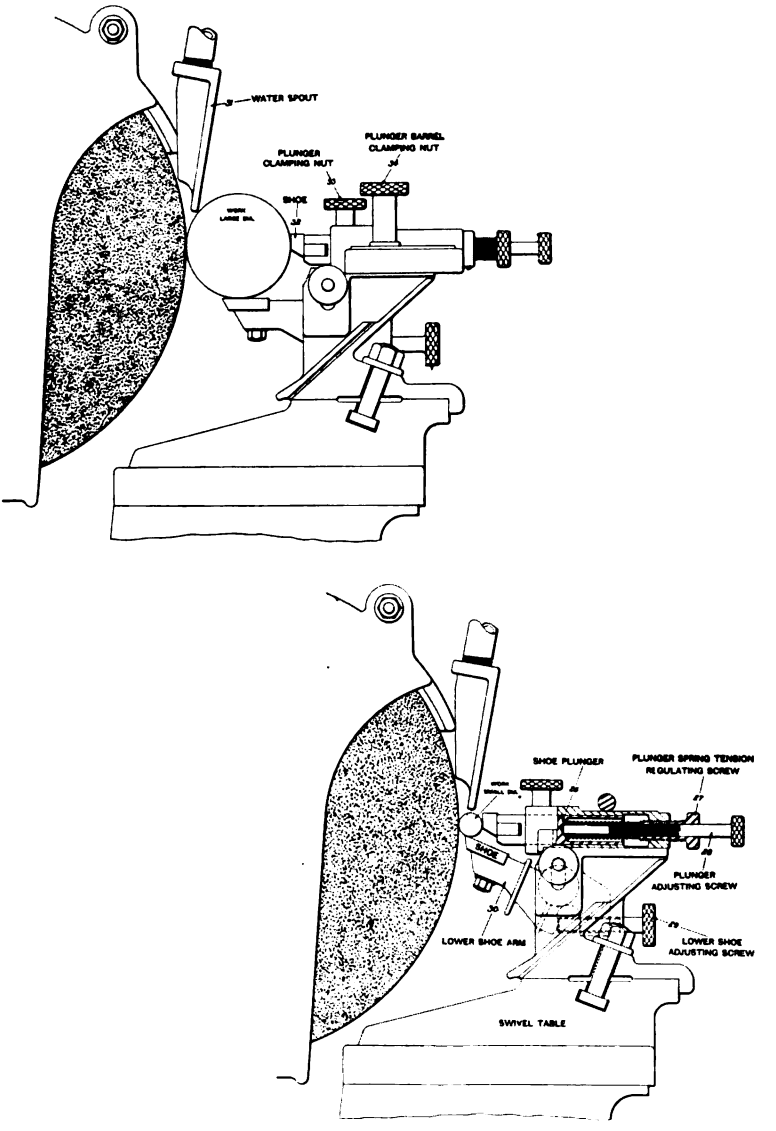


Fig. 9. Stationary Back Rests, showing method of using and extreme setting positions for work of large and small diameters

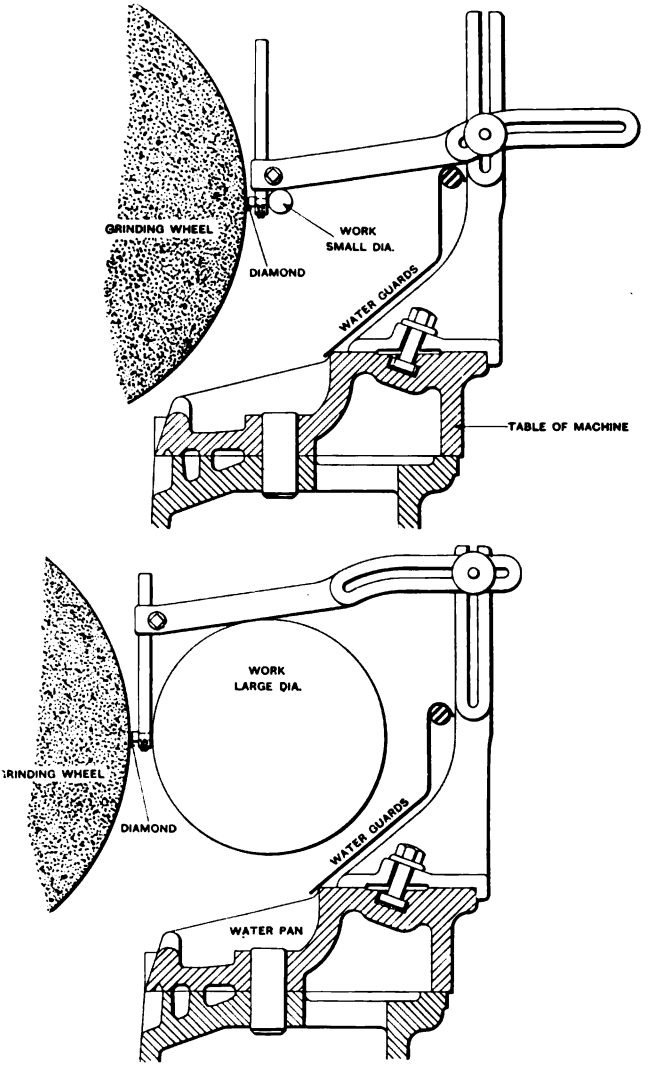


Fig. 10. Grinding Wheel Truing Fixture, showing method of using and extreme setting positions for work of large and small diameters

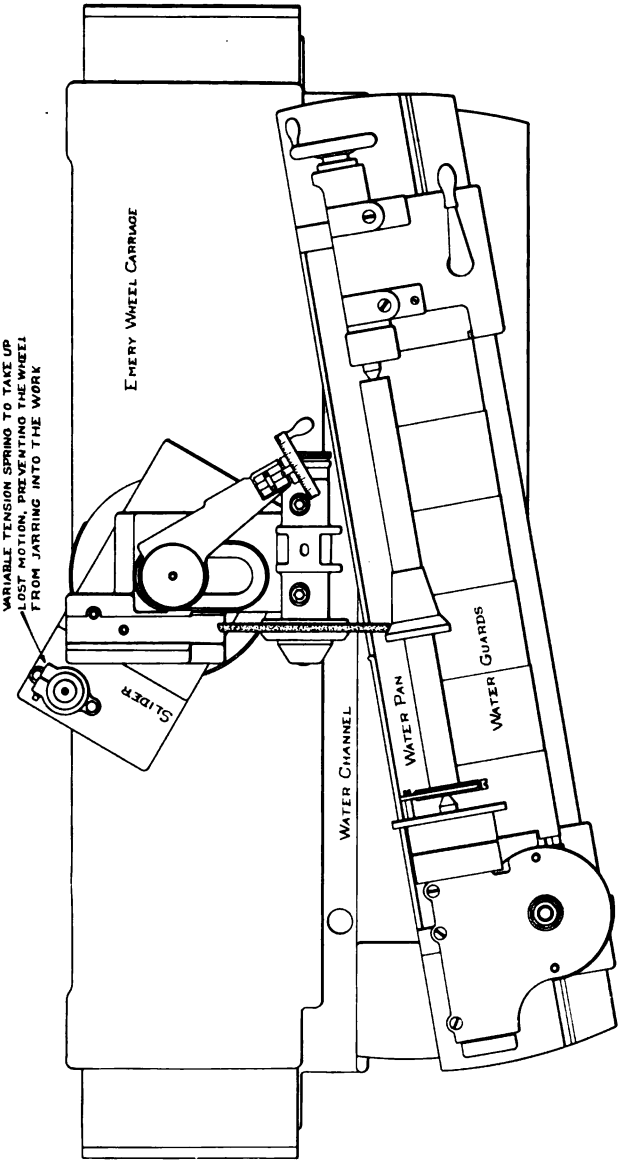


Fig. 11. Grinding Two Tapers

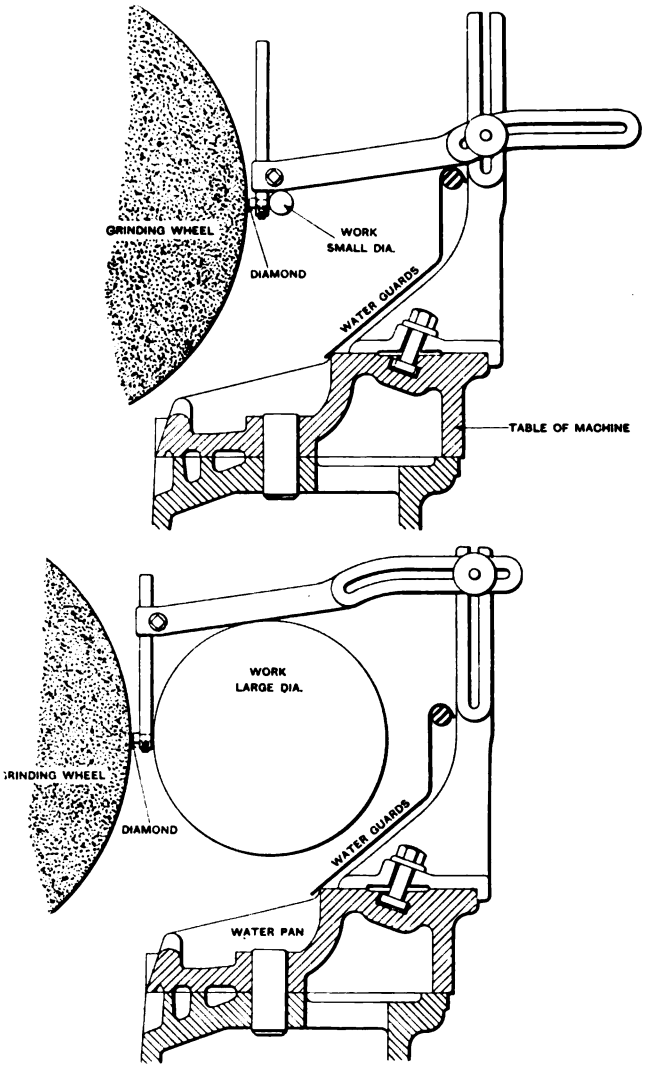


Fig. 10. Grinding Wheel Truing Fixture, showing method of using and extreme setting positions for work of large and small diameters

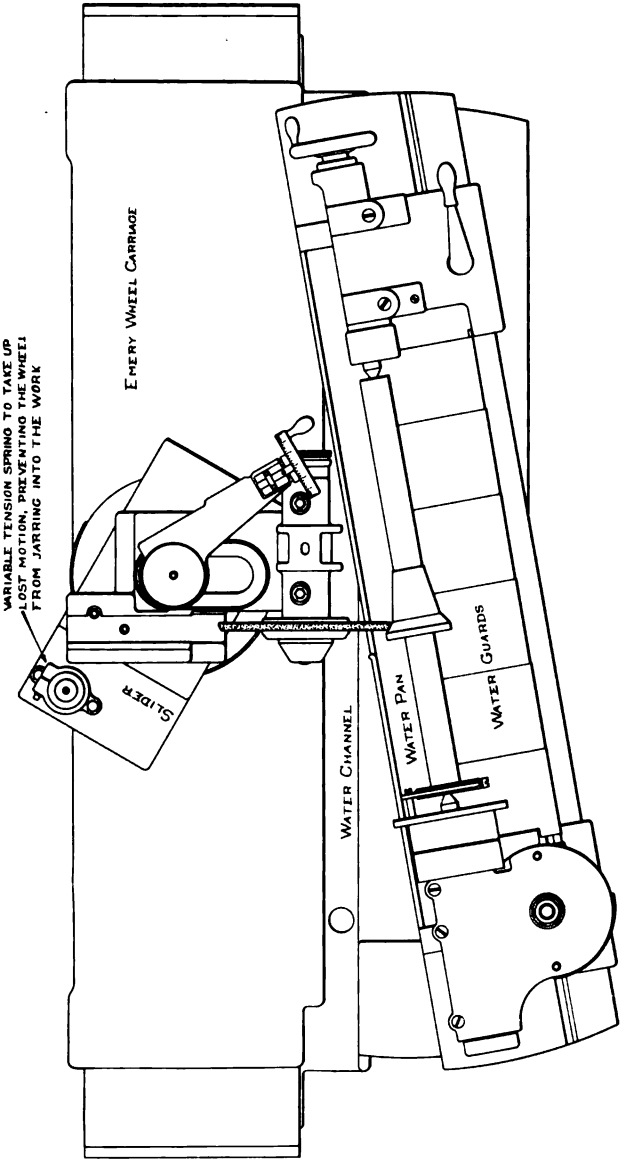


Fig. 11. Grinding Two Tapers

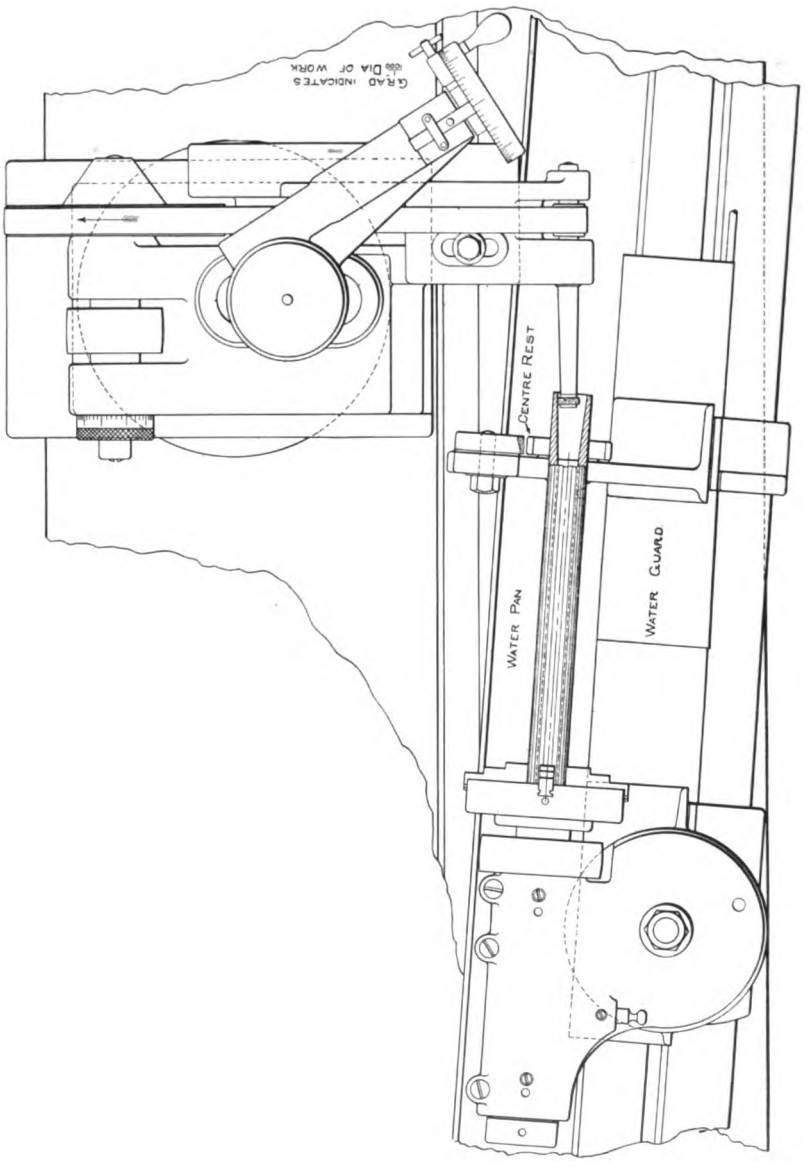


Fig. 12. Grinding Hole in Shaft

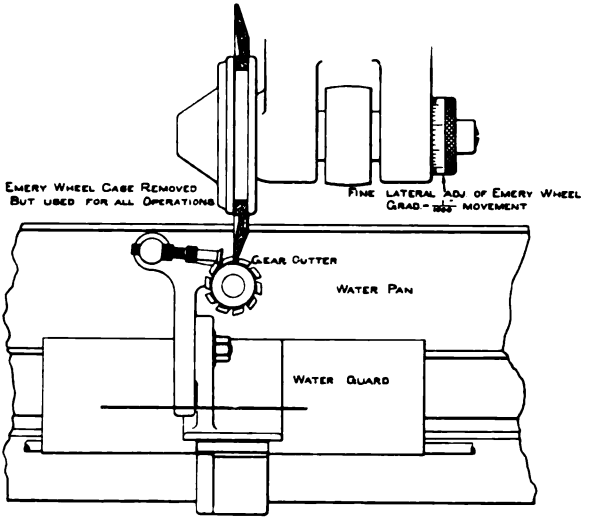


Fig. 13. Grinding Gear Cutter

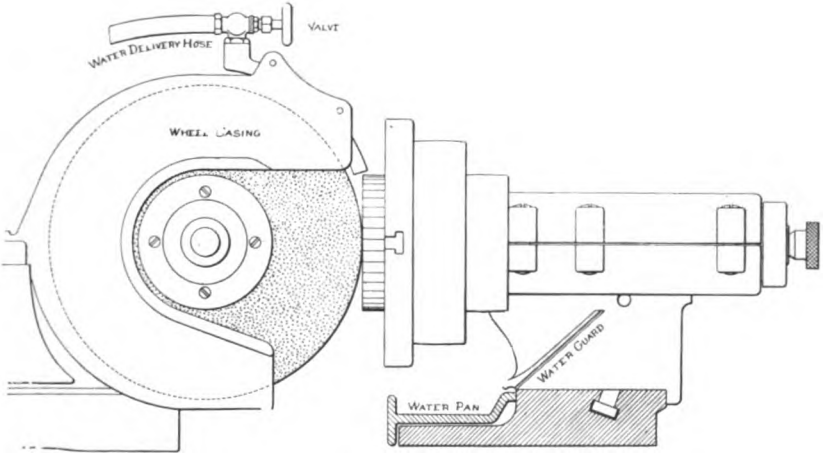


Fig. 14. Grinding Side of Milling Cutter

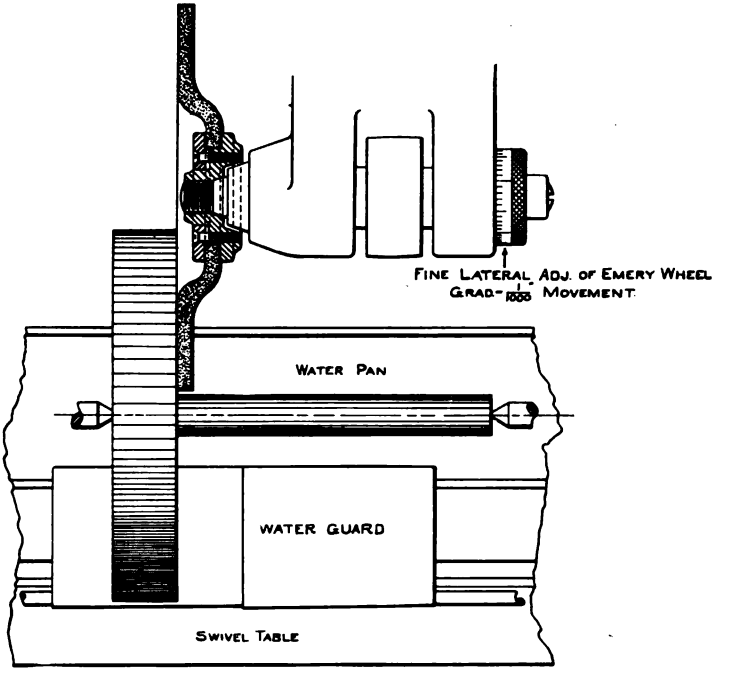


Fig. 15. Grinding Shaft Close to Head

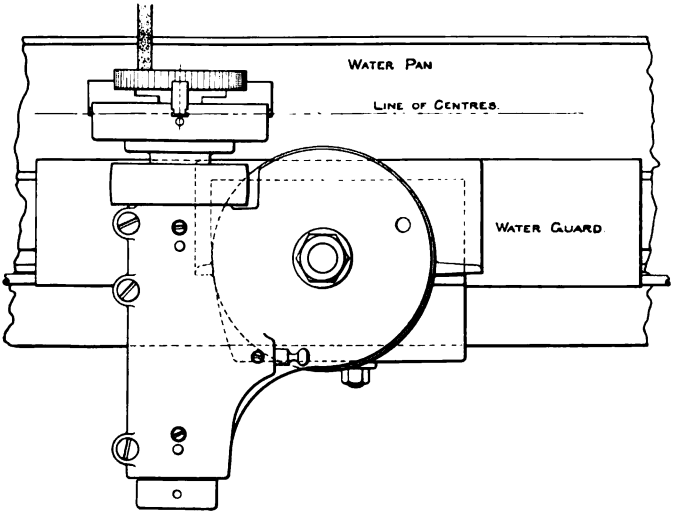


Fig. 16. Face Grinding

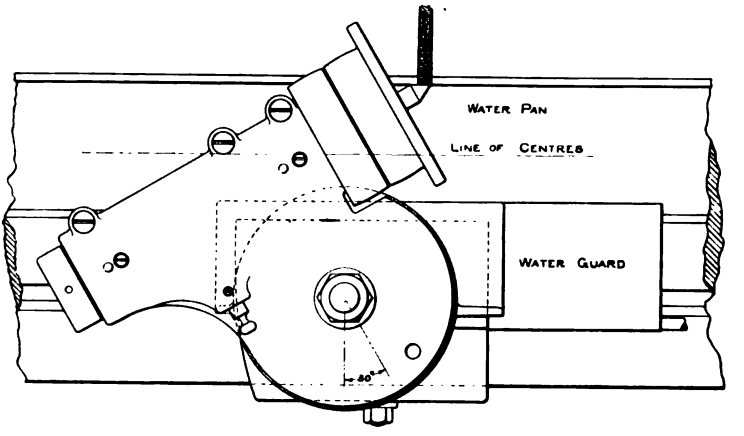


Fig. 17. Grinding Center

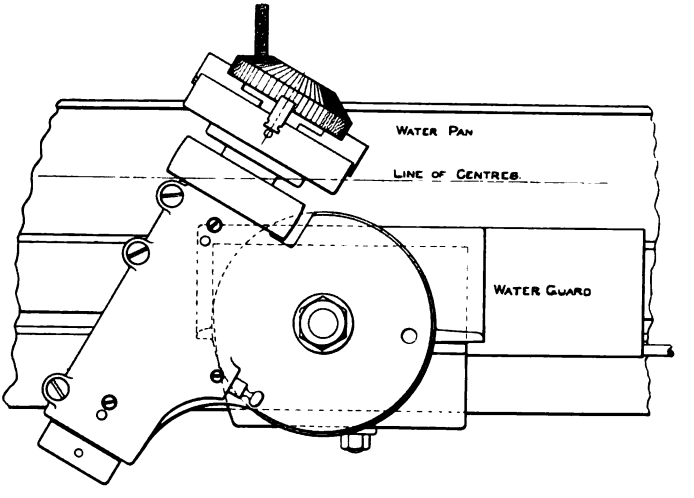


Fig. 18. Grinding Taper in Chuck

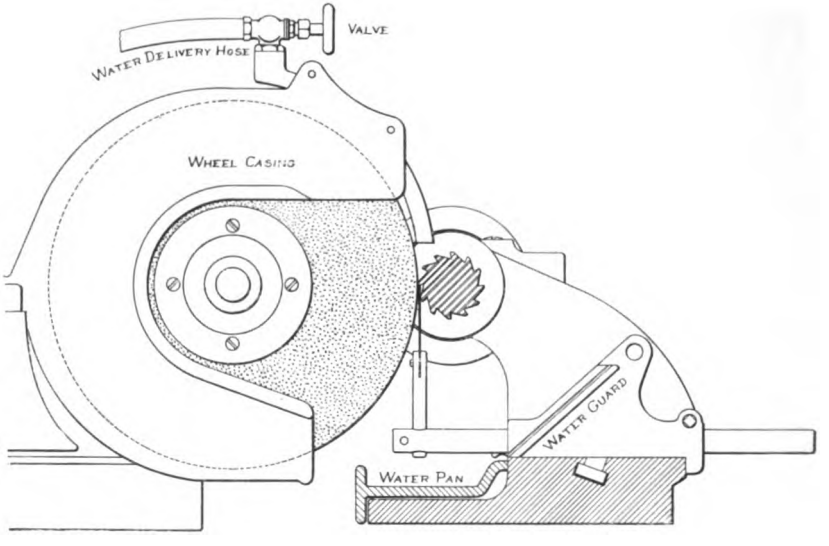


Fig. 19. Grinding Reamer

Landis Tool Company

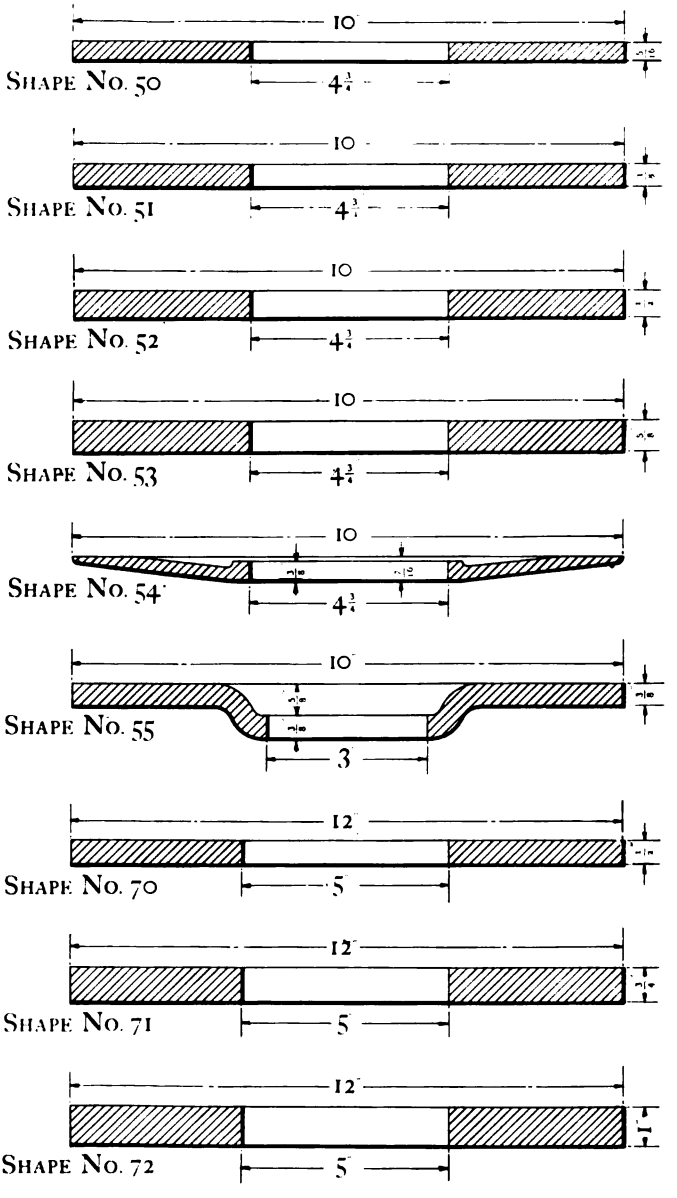
List of Grinding Wheels and Different Machines and Fixtures on Which They Are Used

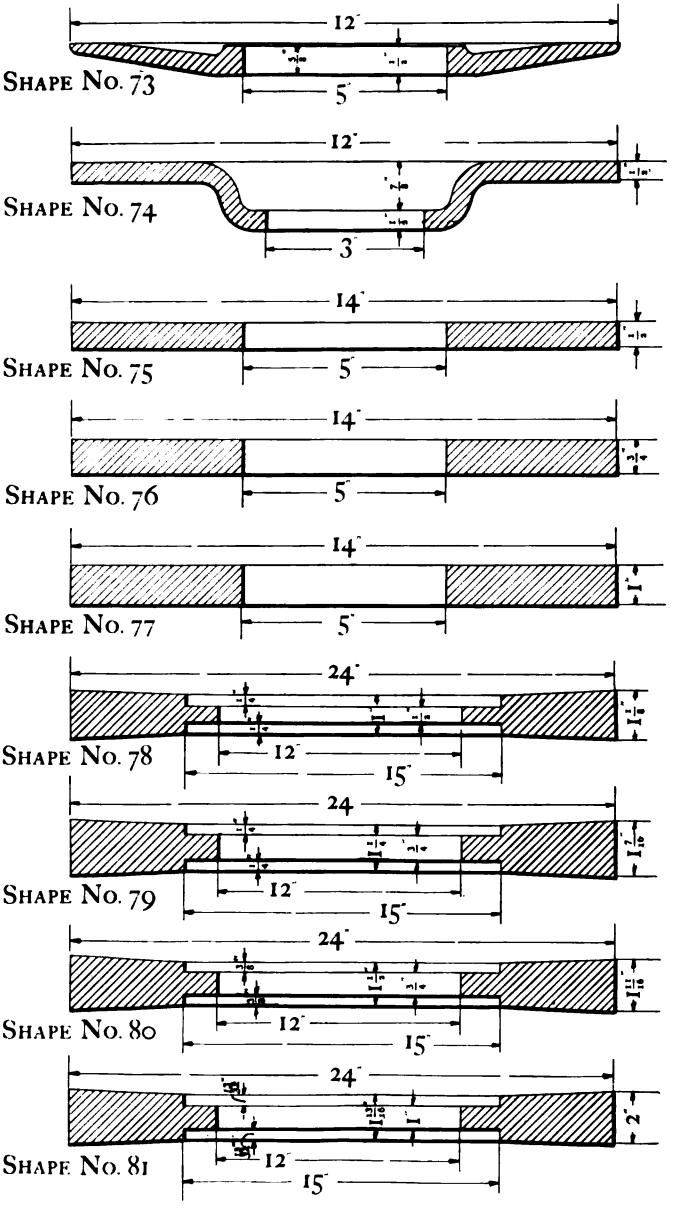
Machines

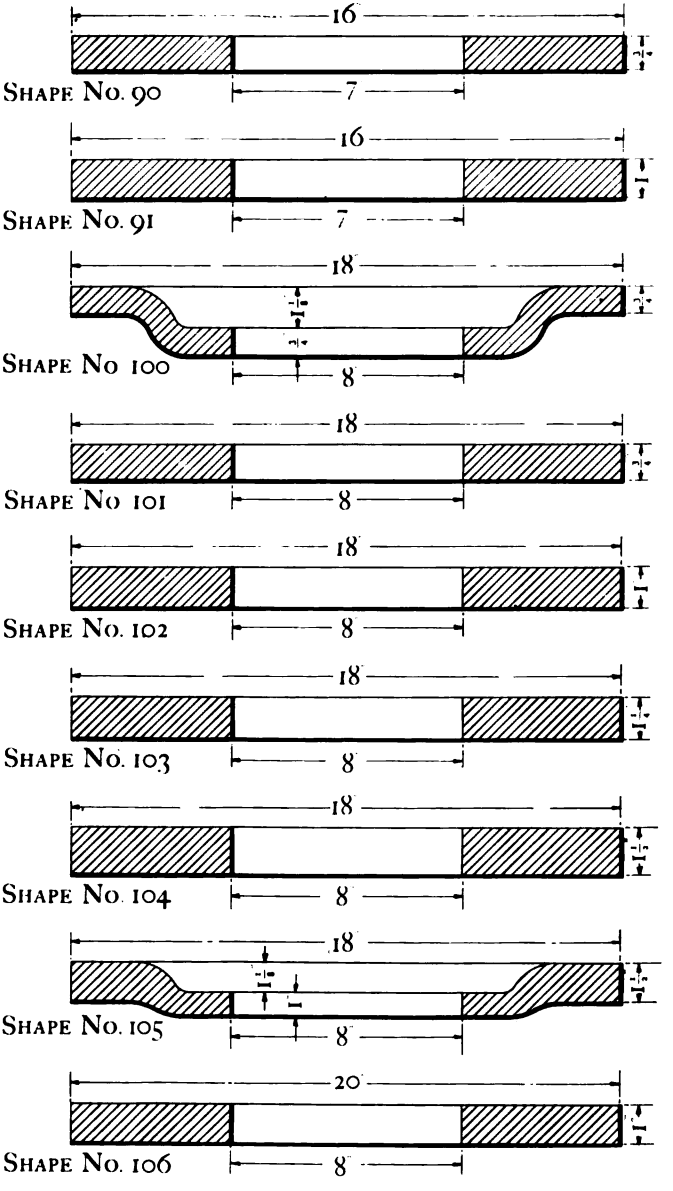
Nos. 1 and 1½ Universal Grinding Machines—
Wheel shapes, Nos. 50, 51, 52, 53, 54, 55, 120 and 121.
Nos. 2, 3 and 4 Universal Grinding Machines—
Wheel shapes, Nos. 70, 71, 72, 73, 74, 75, 76, 77, 119, 120 and 121.
Nos. 7, 8 and 9 Universal Grinding Machines—
Wheel shapes, Nos. 100, 101, 102, 103, 104, 105, 120 and 121.
No. 11, Plain Grinding Machine—
Wheel shapes, Nos. 90 and 91.
Nos. 14, 16, 17, 18 and 19 Plain Grinding Machines—
Wheel shapes, Nos. 106, 107 and 108.
Nos. 14, 16, 17 and 18 Gap Grinding Machines—
Wheel shapes, Nos. 109, 109A and 109B.
Nos. 20 and 21 Plain Machines—
Wheel shapes, Nos. 70, 71 and 72.
Nos. 22, 23, 24, 25 and 26 Plain Grinding Machines—
Wheel shapes, Nos. 101, 102, 103 and 104.
Nos. 27, 28 and 29 Plain and Gap Grinding Machines—
Wheel shapes, Nos. 110, 111, 112 and 113.
Nos. 31, 32, 33, 34, 34½, 35, 36 and 37 Grinding Machines—
Wheel shapes, Nos. 115, 116, 117 and 118.
Nos. 23 and 24 Crank Grinding Machines—
Wheel shapes, Nos. 78, 79 80 and 81.

Internal Grinding Fixtures

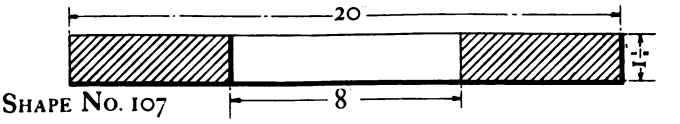
No. 1 Internal Grinding Fixture—
Wheel shapes, Nos. 30, 31 and 32.
No. 2 Internal Grinding Fixture—
Wheel shape, No. 33.
No. 3 Internal Grinding Fixture—
Wheel shapes, Nos. 34 and 35.
No. 4 Internal Grinding Fixture—
Wheel shapes, Nos. 36 and 37.
No. 4½ Internal Grinding Fixture—
Wheel shapes, Nos. 44, 45 and 46.
No. 5 Internal Grinding Fixture—
Wheel shapes, Nos. 38, 39 and 40.
No. 6 Internal Grinding Fixture—
Wheel shapes, Nos. 41, 42 and 43



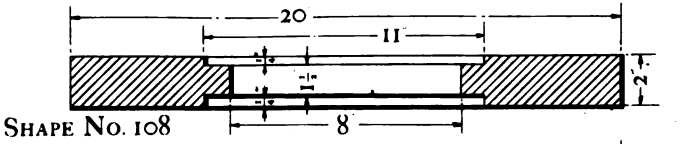




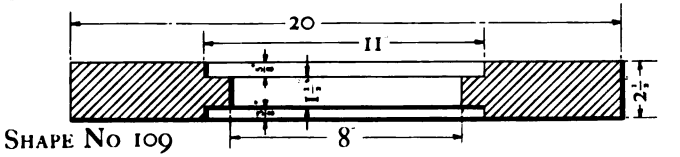
Landis Tool Company



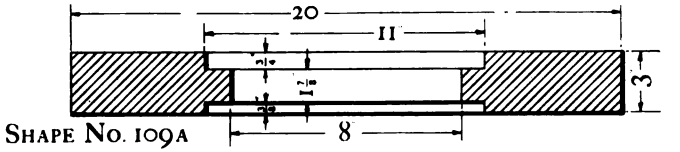
SHAPE NO. 107



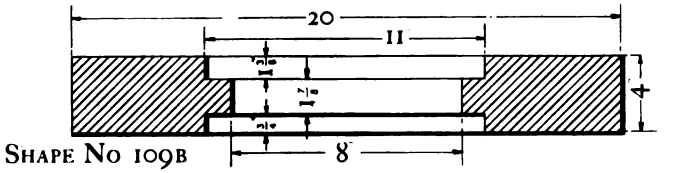
SHAPE NO. 108



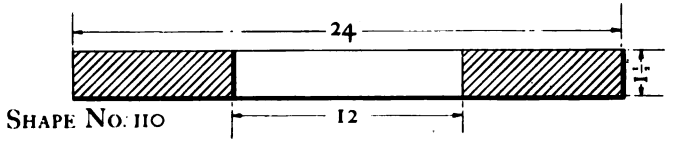
SHAPE NO 109



SHAPE NO. 109A



SHAPE NO 109B



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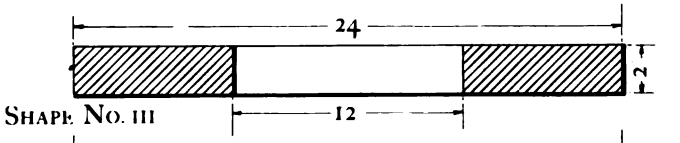
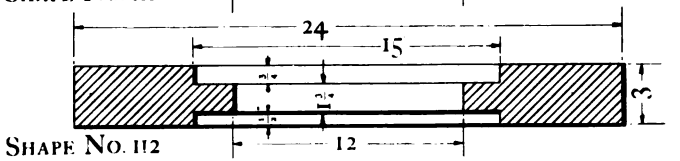
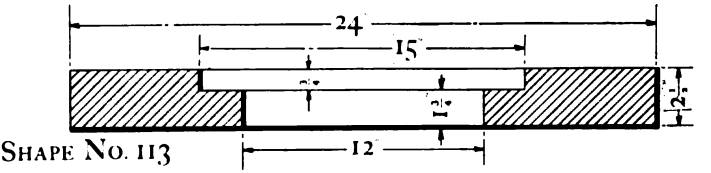


SHAPE NO. 111



SHAPE NO. 112



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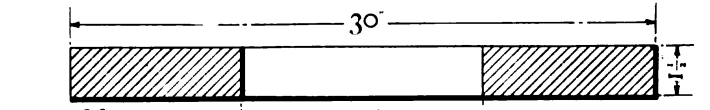

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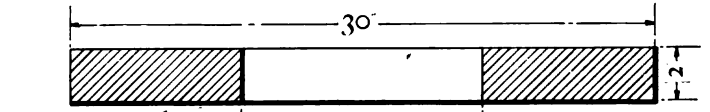
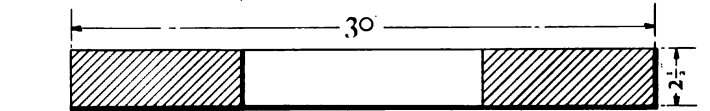


SHAPE NO. 116



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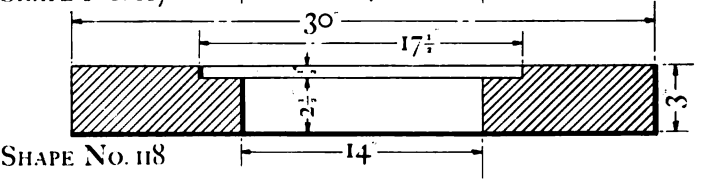
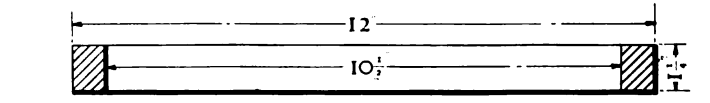
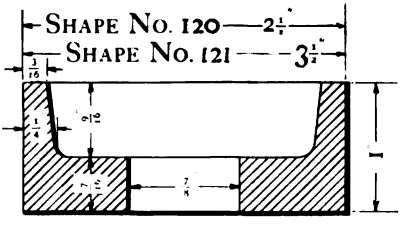


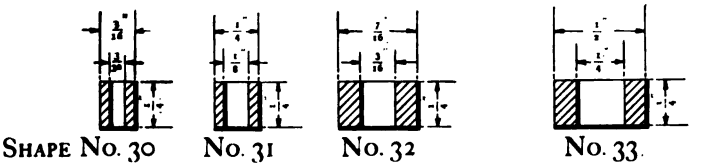
SHAPE NO. 118

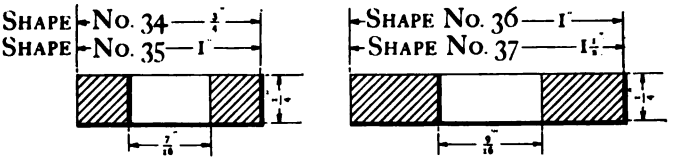


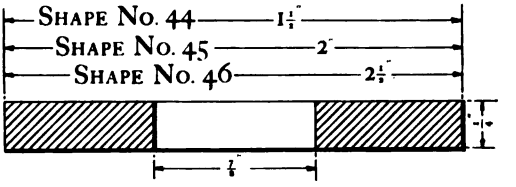
SHAPE NO. 119 **Used on Plain Surface Grinding Fixture**

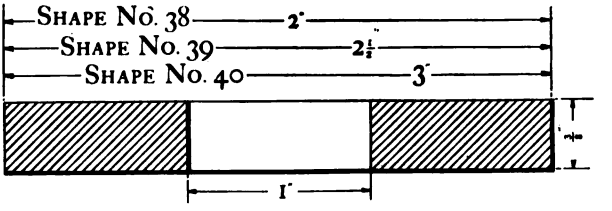


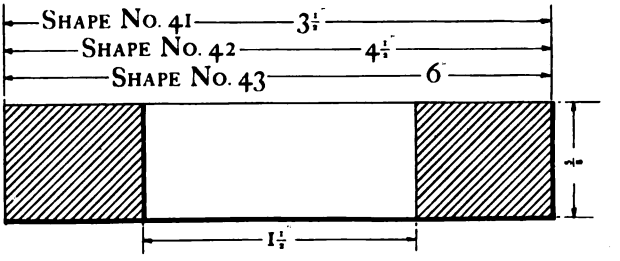
Shapes Nos. 120 and 121 Used on Side Mill Grinding Fixture











Landis Tool Company

Speed for Wheels

The table given below designates number of revolutions per minute for specified diameters of wheels, to cause them to run at the respective periphery rates of 4,000, 5,000 and 6,000 feet per minute.

Diameter Wheel	Revolutions per Minute for Surface Speed of 4,000 Ft.	Revolutions per Minute for Surface Speed of 5,000 Ft.	Revolutions per Minute for Surface Speed of 6,000 Ft.
1 inch	15,267	19,099	22,918
2 "	7,639	9,549	11,459
3 "	5,093	6,366	7,639
4 "	3,820	4,775	5,730
5 "	3,056	3,820	4,584
6 "	2 546	3,183	3,820
7 "	2,183	2,728	3,274
8 "	1,910	2,387	2,865
10 "	1,528	1,910	2,292
12 "	1,273	1,592	1,910
14 "	1,091	1,364	1,637
16 "	955	1,194	1,432
18 "	849	1,061	1,273
20 "	764	955	1,146
22 "	694	868	1,042
24 "	637	796	955
30 "	509	637	764
36 "	424	531	637

The medium of 5,000 feet is usually employed in ordinary work, but in specific cases it is sometimes desirable to run them at a lower or higher rate according to requirements.

We recommend a number of revolutions equivalent to a surface speed of 5,500 feet. This does not indicate that they cannot be run at higher or lower speed, but that it is a good average speed to produce good results. To allow an ample margin of safety it is recommended that wheels should not be run at a surface speed exceeding 6,000 feet.

Every shop should have a speed indicator in order that the speed of its grinding machinery may be known.

Dimensions of Universal Grinding Machines

Machine No.	1	1½	2	2 A	3	3 A	4	4 A	7	8	9
Swing	10 in.	10 in.	12 in.	16 in.	12 in.	16 in.	12 in.	16 in.	20 in.	20 in.	20 in.
Between centers	20 in.	30 in.	32 in.	32 in.	42 in.	42 in.	66 in.	66 in.	72 in.	96 in.	144 in.
Will grind taper in inches per foot	5 in.	4 in.	5 in.	5 in.	4 in.	4 in.	3 in.	3 in.	4 in.	3¾ in.	2½ in.
Headstock swivel graduated to	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°
Diameter of headstock spindle	1¾ in.	1¾ in.	2⅜ in.	2⅜ in.	2⅜ in.	2⅜ in.	2⅜ in.	2⅜ in.	3⅝ in.	3⅝ in.	3⅝ in.
Diameter of footstock spindle	1½ in.	1½ in.	2⅛ in.	2⅛ in.	2⅛ in.	2⅛ in.	2⅛ in.	2⅛ in.	2⅞ in.	2⅞ in.	2⅞ in.
Diameter of work centers	1⅜ in.	1⅜ in.	1⅛ in.	1⅛ in.	1⅛ in.	1⅛ in.	1⅛ in.	1⅛ in.	1⅜ in.	1⅜ in.	1⅜ in.
Diameter of grinding wheel spindle	1 15/16 in.	1 15/16 in.	1½ in.	1½ in.	1½ in.	1½ in.	1½ in.	1½ in.	2¾ in.	2¾ in.	2¾ in.
Diameter of grinding wheel pulley	3 13/16 in.	3 15/16	5½ in.	5½ in.	5½ in.	5½ in.	5½ in.	5½ in.	8 in.	8 in.	8 in.
Diameter of grinding wheel [inches]	10	10	12&14	12 & 14	12 & 14	12 & 14	12 & 14	12 & 14	18	18	18
Face of grinding wheels [inches]	5/16 to 6/8	5/16 to 5/8	½ to 1	½ to 1	½ to 1	½ to 1	½ to 1	½ to 1	¾ to 2	¾ to 2	¾ to 2
Width of grinding wheel belt	1¾ in.	1¾ in.	2½ in.	2½ in.	2½ in.	2½ in.	2½ in.	2½ in.	3½ in.	3½ in.	3½ in.
Grinding wheel swivel graduated on both sides of center line	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°
Diameter counter-shaft main driving pulley	8 in.	8 in.	11 in.	11 in.	11 in.	11 in.	11 in.	11 in.	15 in.	15 in.	15 in.
Width main driving belt	3 in.	3 in.	4 in.	4 in.	4 in.	4 in.	4 in.	4 in.	6 in.	6 in.	6 in.
Floor space	39x82 in.	39x112 in.	48x98 in.	48x98 in.	48x114 in.	48x114 in.	48x150 in.	48x150 in.	67x193 in.	67x217 in.	67x265 in.
Net weight, about	3100 lbs.	3300 lbs.	5400 lbs.	5600 lbs.	5800 lbs.	6000 lbs.	7400 lbs.	7700 lbs.	13300 lbs.	16600 lbs.	19900 lbs.
Gross weight, boxed for export, about	3900 lbs.	4700 lbs.	7000 lbs.	7300 lbs.	7600 lbs.	7900 lbs.	9400 lbs.	9800 lbs.	16300 lbs.	20500 lbs.	24800 lbs.

Dimensions of Plain Grinding Machines

Machine No.	11	14	14 A	16	16 A	17	17 A	18	18 A	19	19 A	20	21
Swing	8 in.	12 in.	16 in.	12 in.	16 in.	12 in.	16 in.	12 in.	16 in.	12 in.	16 in.	10 in.	10 in.
Between centers	32 in.	48 in.	48 in.	72 in.	72 in.	96 in.	96 in.	120 in.	120 in.	144 in.	144 in.	20 in.	30 in.
Will grind taper in inches per foot	4 in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$2\frac{3}{4}$ in.	$2\frac{3}{4}$ in.	$2\frac{1}{4}$ in.	$2\frac{1}{4}$ in.	$1\frac{3}{4}$ in.	$1\frac{3}{4}$ in.	$1\frac{1}{4}$ in.	$1\frac{1}{4}$ in.	5 in.	4 in.
Diameter of headstock spindle	$1\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$1\frac{7}{8}$ in.	$1\frac{7}{8}$ in.
Diameter of footstock spindle	$1\frac{1}{2}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$1\frac{1}{2}$ in.	$1\frac{1}{2}$ in.
Diameter of work centers	$1\frac{3}{16}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{16}$ in.	$1\frac{3}{16}$ in.
Diameter of grinding wheel spindle	3 in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$2\frac{1}{4}$ in.	$2\frac{1}{4}$ in.
Diameter of grinding wheel pulley	$6\frac{1}{4}$ in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	$4\frac{3}{4}$ in.	$4\frac{3}{4}$ in.
Diameter of grinding wheel	16 in.	20 in.	20 in.	20 in.	20 in.	20 in.	20 in.	20 in.	20 in.	20 in.	20 in.	12 in.	12 in.
Face of grinding wheels....[inch]	$\frac{3}{4}$ to $1\frac{1}{2}$	1 to $2\frac{1}{2}$	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	$\frac{1}{2}$ to 1	$\frac{1}{2}$ to 1
Width of grinding wheel belt	$2\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	2 in.	2 in.
Diameter countershaft main driving pulley	11 in.	15 in.	15 in.	15 in.	15 in.	15 in.	15 in.	15 in.	15 in.	15 in.	15 in.	8 in.	8 in.
Width main driving belt	4 in.	6 in.	6 in.	6 in.	6 in.	6 in.	6 in.	6 in.	6 in.	6 in.	6 in.	3 in.	3 in.
Floor space	46x105 in.	54x152 in.	54x152 in.	54x200 in.	54x200 in.	60x248 in.	60x248 in.	60x296 in.	60x296 in.	60x344 in.	60x344 in.	39x82 in.	39x82 in.
Net weight, about	4600 lbs.	10200 lbs.	10400 lbs	11500 lbs.	11700 lbs.	14100 lbs.	14300 lbs.	16200 lbs.	16400 lbs.	19000 lbs.	19200 lbs.	3200 lbs.	3700 lbs.
Gross weight, boxed for export, about	6100 lbs.	13200 lbs.	13500 lbs.	15200 lbs.	15500 lbs.	18000 lbs.	18300 lbs.	20800 lbs.	21100 lbs.	23600 lbs.	23900 lbs.	4300 lbs.	4800 lbs.

Dimensions of Plain Grinding Machines—*Continued*

Machine No.	22	22A	23	23A	24	24A	25	25A	26	26A	27	28	29
Swing	12 in.	16 in.	12 in.	16 in.	12 in.	16 in.	12 in.	16 in.	12 in.	16 in.	20 in.	20 in.	20 in.
Between centers	32 in.	32 in.	42 in.	42 in.	66 in.	66 in.	96 in.	96 in.	120 in.	120 in.	72 in.	96 in.	144 in.
Will grind taper in inches per foot	5 in.	5 in.	4 in.	4 in.	3 in.	3 in.	$2\frac{1}{4}$ in.	$2\frac{1}{4}$ in.	$1\frac{7}{8}$ in.	$1\frac{7}{8}$ in.	4 in.	$3\frac{1}{4}$ in.	$2\frac{1}{2}$ in.
Diameter of headstock spindle	$2\frac{3}{8}$ in.	$2\frac{3}{8}$ in.	$2\frac{3}{8}$ in.	$2\frac{3}{8}$ in.	$2\frac{3}{8}$ in.	$2\frac{3}{8}$ in.	$2\frac{3}{8}$ in.	$2\frac{3}{8}$ in.	$2\frac{3}{8}$ in.	$2\frac{3}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.
Diameter of footstock spindle	$2\frac{1}{8}$ in.	$2\frac{1}{8}$ in.	$2\frac{1}{8}$ in.	$2\frac{1}{8}$ in.	$2\frac{1}{8}$ in.	$2\frac{1}{8}$ in.	$2\frac{1}{8}$ in.	$2\frac{1}{8}$ in.	$2\frac{1}{8}$ in.	$2\frac{1}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.
Diameter of work centers	$1\frac{1}{8}$ in.	$1\frac{1}{8}$ in.	$1\frac{1}{8}$ in.	$1\frac{1}{8}$ in.	$1\frac{1}{8}$ in.	$1\frac{1}{8}$ in.	$1\frac{1}{8}$ in.	$1\frac{1}{8}$ in.	$1\frac{1}{8}$ in.	$1\frac{1}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.
Diameter of grinding wheel spindle	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$4\frac{1}{2}$ in.	$4\frac{1}{2}$ in.	$4\frac{1}{2}$ in.
Diameter of grinding wheel pulley	7 in.	7 in.	7 in.	7 in.	7 in.	7 in.	7 in.	7 in.	7 in.	7 in.	12 in.	12 in.	12 in.
Diameter of grinding wheel	18 in.	18 in.	18 in.	18 in.	18 in.	18 in.	18 in.	18 in.	18 in.	18 in.	24 in.	24 in.	24 in.
Face of grinding wheels [inches]	$\frac{3}{4}$ to 2	$\frac{3}{4}$ to $2\frac{1}{2}$	$\frac{3}{4}$ to $2\frac{1}{2}$	$\frac{3}{4}$ to $2\frac{1}{2}$	$\frac{3}{4}$ to $2\frac{1}{2}$	$\frac{3}{4}$ to $2\frac{1}{2}$	$\frac{3}{4}$ to $2\frac{1}{2}$	$\frac{3}{4}$ to $2\frac{1}{2}$	$\frac{3}{4}$ to $2\frac{1}{2}$	$\frac{3}{4}$ to $2\frac{1}{2}$	$1\frac{1}{2}$ to $3\frac{1}{2}$	$1\frac{1}{2}$ to $3\frac{1}{2}$	$1\frac{1}{2}$ to $3\frac{1}{2}$
Width of grinding wheel belt	3 in.	3 in.	3 in.	3 in.	3 in.	3 in.	3 in.	3 in.	3 in.	3 in.	$4\frac{1}{2}$ in.	$4\frac{1}{2}$ in.	$4\frac{1}{2}$ in.
Diameter countershaft main driving pulley	11 in.	11 in.	11 in.	11 in.	11 in.	11 in.	15 in.	15 in.	15 in.	15 in.	15 in.	15 in.	15 in.
Width main driving belt	4 in.	4 in.	4 in.	4 in.	4 in.	4 in.	6 in.	6 in.	6 in.	6 in.	6 in.	6 in.	6 in.
Floor space	48x98 in.	48x98 in.	48x114 in.	48x114 in.	48x150 in.	48x150 in.	54x216 in.	54x216 in.	54x264 in.	54x264 in.	67x196 in.	67x220 in.	67x268 in.
Net weight, about	4000 lbs.	4100 lbs.	5900 lbs.	6000 lbs.	8300 lbs.	8400 lbs.	10400 lbs.	10500 lbs.	12300 lbs.	12400 lbs.	14400 lbs.	17400 lbs.	20700 lbs.
Gross weight, boxed for export, about	6000 lbs.	6200 lbs.	7800 lbs.	8000 lbs.	10100 lbs.	10300 lbs.	12200 lbs.	12400 lbs.	14300 lbs.	14500 lbs.	17900 lbs.	21800 lbs.	25600 lbs.

Dimensions Plain Self-Contained Grinding Machines

Machine No.	14	14A	16	16A	17	17A	18	18A	19	19A
Swing	12 in.	16 in.	12 in.	16 in.	12 in.	16 in.	12 in.	16 in.	12 in.	16 in.
Between centers	48 in.	48 in.	72 in.	72 in.	96 in.	96 in.	120 in.	120 in.	144 in.	144 in.
Will grind taper in inches per foot	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$2\frac{3}{4}$ in.	$2\frac{3}{4}$ in.	$2\frac{1}{4}$ in.	$2\frac{1}{4}$ in.	2 in.	2 in.	$1\frac{1}{4}$ in.	$1\frac{1}{4}$ in.
Diameter of headstock spindle	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.
Diameter of footstock spindle	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.	$2\frac{7}{8}$ in.
Diameter of work centers	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.	$1\frac{3}{8}$ in.
Diameter of grinding wheel spindle	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.	$3\frac{3}{4}$ in.
Diameter of grinding wheel pulley	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.
Diameter of grinding wheel	20 in.	20 in.	20 in.	20 in.	20 in.	20 in.	20 in.	20 in.	20 in.	20 in.
Face of grinding wheel	$\frac{3}{4}$ to 3 in.	$\frac{3}{4}$ to 3 in.	$\frac{3}{4}$ to 3 in.	$\frac{3}{4}$ to 3 in.	$\frac{3}{4}$ to 3 in.	$\frac{3}{4}$ to 3 in.	$\frac{3}{4}$ to 3 in.	1 to 3 in.	1 to 3 in.	1 to 3 in.
Width of grinding wheel belt	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.
Diameter of main driving pulley when arranged for belt drive	12 in.	12 in.	12 in.	12 in.	12 in.	12 in.	12 in.	12 in.	12 in.	12 in.
Width of main driving belt	5 in.	5 in.	5 in.	5 in.	5 in.	5 in.	5 in.	5 in.	5 in.	5 in.
Floor space	72x152 in.	72x152 in.	72x200 in.	72x200 in.	78x248 in.	78x248 in.	78x296 in.	78x296 in.	78x344 in.	78x344 in.
Net weight, about	9200 lbs.	9400 lbs.	10500 lbs.	10700 lbs.	12500 lbs.	12700 lbs.	15300 lbs.	15500 lbs.	18000 lbs.	18200 lbs.
Gross weight, boxed for export, about	12200 lbs.	12500 lbs.	14200 lbs.	14500 lbs.	17000 lbs.	17300 lbs.	19500 lbs.	19800 lbs.	22600 lbs.	22900 lbs.

Dimensions Plain Self-Contained Grinding Machines—*Continued*

Machine No.	31	32	33	34	34½	35	36	37
Swing	20 in.	20 in.	20 in.	20 in.	20 in.	30 in.	30 in.	30 in.
Between centers	78 in.	102 in.	150 in.	174 in.	198 in.	150 in.	174 in.	198 in.
Will grind taper in inches per foot	4 in.	3½ in.	2½ in.	2¼ in.	2 in.	3¼ in.	3 in.	2½ in.
Diameter of headstock spindle	4¼ in.	4¼ in.	4¼ in.	4¼ in.	4¼ in.	5 in.	5 in.	5 in.
Diameter of footstock spindle	3½ in.	3½ in.	3½ in.	3½ in.	3½ in.	4½ in.	4½ in.	4½ in.
Diameter of work centers	2 in.	2 in.	2 in.	2 in.	2 in.	2¾ in.	2¾ in.	2¾ in.
Diameter of grinding wheel spindle	4⅞ in.	4⅞ in.	4⅞ in.	4⅞ in.	4⅞ in.	4⅞ in.	4⅞ in.	4⅞ in.
Diameter of grinding wheel pulley	14 in.	14 in.	14 in.	14 in.	14 in	14 in.	14 in.	14 in.
Diameter of grinding wheel	30 in.	30 in.	30 in.	30 in.	30 in.	30 in.	30 in.	30 in.
Face of grinding wheel	1½ to 3 in.	1½ to 3 in.	1½ to 3 in.	1½ to 3 in.	1½ to 3 in.	1½ to 3 in.	1½ to 3 in.	1½ to 3 in.
Width of grinding wheel belt	4½ in.	4½ in.	4½ in.	4½ in.	4½ in.	4½ in.	4½ in.	4½ in.
Diameter of main driving pulley when ar-ranged for belt drive	18 in.	18 in.	18 in.	18 in.	18 in.	18 in.	18 in.	18 in.
Width of main driving belt	8 in.	8 in.	8 in.	8 in.	8 in.	8 in.	8 in.	8 in.
Floor space	100 x 211 in.	100 x 235 in.	100 x 283 in.	100 x 307 in.	100 x 331 in.	108 x 283 in.	108 x 307 in.	108 x 331 in.
Net weight, about	25900 lbs.	27800 lbs.	29400 lbs.	31200 lbs.	33000 lbs.	33000 lbs.	36000 lbs.	42000 lbs.
Gross weight, boxed for export, about	29000 lbs.	32200 lbs.	35800 lbs.	38200 lbs.	40600 lbs.	40000 lbs.	44000 lbs.	49000 lbs.

Dimensions of Gap Machines

Machine No.	16	16 A	17	17 A	18	18 A	27	28	29
Swing over table	12 in.	16 in.	12 in.	16 in.	12 in.	16 in.	20 in.	20 in.	20 in.
Swing in gap	28 in.	32 in.	28 in.	32 in.	28 in.	32 in.	36 in.	36 in.	36 in.
Width of gap	15 in.	15 in.	15 in.	15 in.	15 in.	15 in.	18 in.	18 in.	18 in.
Diameter of head-stock spindle	2⅞ in.	2⅞ in.	2⅞ in.	2⅞ in.	2⅞ in.	2⅞ in.	2⅞ in.	2⅞ in.	2⅞ in.
Diameter of foot-stock spindle	2⅞ in.	2⅞ in.	2⅞ in.	2⅞ in.	2⅞ in.	2⅞ in.	2⅞ in.	2⅞ in.	2⅞ in.
Diameter of work centers	1⅜ in.	1⅜ in.	1⅜ in.	1⅜ in.	1⅜ in.	1⅜ in.	1⅜ in.	1⅜ in.	1⅜ in.
Diameter of grinding wheel spindle	3¾ in.	3¾ in.	3¾ in.	3¾ in.	3¾ in.	3¾ in.	4½ in.	4½ in.	4½ in.
Diameter of grinding wheel pulley	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	12 in.	12 in.	12 in.
Diameter of grinding wheel	20 in.	20 in.	20 in.	20 in.	20 in.	20 in.	24 in.	24 in.	24 in.
Face of grinding wheel	2 to 4 in.	2 to 4 in.	2 to 4 in.	2 to 4 in.	2 to 4 in.	2 to 4 in.	2 to 4 in.	2 to 4 in.	2 to 4 in.
Width of grinding wheel belt	3½ in.	3½ in.	3½ in.	3½ in.	3½ in.	3½ in.	4½ in.	4½ in.	4½ in.
Diameter countershaft main driving pulley	15 in.	15 in.	15 in.	15 in.	15 in.	15 in.	15 in.	15 in.	15 in.
Width of main driving belt	6 in.	6 in.	6 in.	6 in.	6 in.	6 in.	6 in.	6 in.	6 in.
Floor space	54 x 200 in.	54 x 200 in.	60 x 248 in.	60 x 248 in.	60 x 296 in.	60 x 296 in.	67 x 196 in.	67 x 220 in.	67x268 in.
Net weight, about	11500 lbs.	11700 lbs.	14100 lbs.	14300 lbs.	16200 lbs.	16400 lbs.	14400 lbs.	17400 lbs.	20700 lbs.
Gross weight boxed for export, about	15200 lbs.	15500 lbs.	18000 lbs.	18300 lbs.	20800 lbs.	21100 lbs.	17900 lbs.	21800 lbs.	25600 lbs.

14, 14 A, 16, 16 A, 18 and 18 A also made in self-contained.

Landis Tool Company

Table of Decimal Equivalents

8th, 16th, 32ds and 64ths of an inch

8ths

$\frac{1}{8}$ = .125
$\frac{2}{8}$ = .250
$\frac{3}{8}$ = .375
$\frac{4}{8}$ = .500
$\frac{5}{8}$ = .625
$\frac{6}{8}$ = .750
$\frac{7}{8}$ = .875

16ths

$\frac{1}{16}$ = .0625
$\frac{3}{16}$ = .1875
$\frac{5}{16}$ = .3125
$\frac{7}{16}$ = .4375
$\frac{9}{16}$ = .5625
$\frac{11}{16}$ = .6875
$\frac{13}{16}$ = .8125
$\frac{15}{16}$ = .9375

32ds

$\frac{1}{32}$ = .03125
$\frac{3}{32}$ = .09375
$\frac{5}{32}$ = .15625
$\frac{7}{32}$ = .21875
$\frac{9}{32}$ = .28125
$\frac{11}{32}$ = .34375
$\frac{13}{32}$ = .40625
$\frac{15}{32}$ = .46875
$\frac{17}{32}$ = .53125
$\frac{19}{32}$ = .59375
$\frac{21}{32}$ = .65625
$\frac{23}{32}$ = .71875
$\frac{25}{32}$ = .78125
$\frac{27}{32}$ = .84375
$\frac{29}{32}$ = .90625
$\frac{31}{32}$ = .96875

64ths

$\frac{1}{64}$ = .015625
$\frac{3}{64}$ = .046875
$\frac{5}{64}$ = .078125
$\frac{7}{64}$ = .109375
$\frac{9}{64}$ = .140625
$\frac{11}{64}$ = .171875
$\frac{13}{64}$ = .203125
$\frac{15}{64}$ = .234375
$\frac{17}{64}$ = .265625
$\frac{19}{64}$ = .296875
$\frac{21}{64}$ = .328125
$\frac{23}{64}$ = .359375
$\frac{25}{64}$ = .390625
$\frac{27}{64}$ = .421875
$\frac{29}{64}$ = .453125
$\frac{31}{64}$ = .484375
$\frac{33}{64}$ = .515625
$\frac{35}{64}$ = .546875
$\frac{37}{64}$ = .578125
$\frac{39}{64}$ = .609375
$\frac{41}{64}$ = .640625
$\frac{43}{64}$ = .671875
$\frac{45}{64}$ = .703125
$\frac{47}{64}$ = .734375
$\frac{49}{64}$ = .765625
$\frac{51}{64}$ = .796875
$\frac{53}{64}$ = .828125
$\frac{55}{64}$ = .859375
$\frac{57}{64}$ = .890625
$\frac{59}{64}$ = .921875
$\frac{61}{64}$ = .953125
$\frac{63}{64}$ = .984375

Landis Tool Company

Table of Decimal Equivalents of Millimeters and Fractions of Millimeters

Mm.	Inches	Mm.	Inches	Mm.	Inches
1/50	.00079	26/50	.02047	2	.07874
2/50	.00157	27/50	.02126	3	.11811
3/50	.00236	28/50	.02205	4	.15748
4/50	.00315	29/50	.02283	5	.19685
5/50	.00394	30/50	.02362	6	.23622
6/50	.00472	31/50	.02441	7	.27559
7/50	.00551	32/50	.02520	8	.31496
8/50	.00630	33/50	.02598	9	.39433
9/50	.00709	34/50	.02677	10	.39370
10/50	.00787	35/50	.02756	11	.43307
11/50	.00866	36/50	.02835	12	.47244
12/50	.00945	37/50	.02913	13	.51181
13/50	.01024	38/50	.02992	14	.55118
14/50	.01102	39/50	.03071	15	.59055
15/50	.01181	40/50	.03150	16	.62992
16/50	.01260	41/50	.03228	17	.66929
17/50	.01339	42/50	.03307	18	.70866
18/50	.01417	43/50	.03386	19	.74803
19/50	.01496	44/50	.03465	20	.78740
20/50	.01575	45/50	.03543	21	.82677
21/50	.01654	46/50	.03622	22	.86614
22/50	.01732	47/50	.03701	23	.90551
23/50	.01811	48/50	.03780	24	.94488
24/50	.01890	49/50	.03858	25	.98425
25/50	.01969	1	.03937	26	1.02362

10 mm. = 1 Centimeter = 0.3937 inches.
10 cm. = 1 Decimeter = 3.937 inches.
10 dm. = 1 Meter = 39.37 inches.
25.4 mm. = 1 English inch.

Landis Tool Company

List of Nine Different Standard Gauges Used in the United States

DECIMAL EQUIVALENTS (Inches)

No. of Gauge	American or Brown & Sharpe Iron Wire	Birmingham or Stubbs Iron Wire	Washburn & Moen Iron Wire	Imperial Wire Gauge	U.S.Standard for Plate (Iron & Steel)	Stubbs Steel Wire	Twist Drill and Steel Wire	Washburn & Moen Music Wire	Wood and Mechine Screws	No. of Gauge	Fractional Parts of an Inch	Decimal Equivalents of Sixty-fourths, etc.
8–0							This gauge from one to three thousandths larger than same Nos. of Stubbs steel wire gauge	.0083		8–0	1/64	.01563
7–0					.500			.0087		7–0	1/32	.03125
6–0				.464	.469			.0095		6–0	1/16	.625
5–0				.432	.438			.010		5–0	5/64	.07813
4–0	.460	.454	.394	.400	.406			.011		4–0	3/32	.09375
3–0	.410	.425	.363	.372	.375			.012	.032	3–0	7/64	.10938
2–0	.365	.380	.331	.348	.344			.013	.045	2–0	1/8	.125
0	.325	.340	.307	.334	.313			.014	.058	0	9/64	.14063
1	.289	.300	.283	.300	.281	.277	.228	.016	.071	1	5/32	.15625
2	.258	.284	.263	.276	.266	.219	.221	.017	.084	2	11/64	.17188
3	.229	.259	.244	.252	.250	.212	.213	.018	.097	3	3/16	.1875
4	.204	.238	.225	.232	.234	.207	.209	.019	.110	4	13/64	.20313
5	.182	.220	.207	.212	.219	.204	.206	.020	.124	5	7/32	.21875
6	.162	.203	.192	.192	.203	.201	.204	.022	.137	6	15/64	.23438
7	.144	.180	.177	.176	.188	.199	.201	.023	.150	7	1/4	.25
8	.128	.165	.162	.160	.172	.197	.199	.024	.163	8	17/64	.26563
9	.114	.148	.148	.144	.156	.194	.196	.026	.176	9	9/32	.28125
10	.102	.134	.135	.128	.141	.191	.194	.027	.089	10	19/64	.29688
11	.091	.120	.121	.116	.125	.188	.191	.028	.203	11	5/16	.3125
12	.081	.109	.106	.104	.109	.185	.189	.030	.216	12	21/64	.32813
13	.072	.095	.092	.092	.094	.182	.185	.031	.229	13	11/32	.34375
14	.064	.083	.080	.080	.078	.180	.182	.033	.242	14	23/64	.35938
15	.057	.072	.072	.072	.070	.178	.180	.035	.255	15	3/8	.375
16	.051	.065	.063	.064	.063	.175	.177	.036	.268	16	25/64	.39063
17	.045	.058	.054	.056	.056	.172	.173	.038	.282	17	13/32	.40625
18	.040	.049	.048	.048	.050	.168	.170	.040	.295	18	27/64	.42188
19	.036	.042	.041	.040	.044	.164	.166	.041	.308	19	7/16	.4375
20	.032	.035	.035	.036	.038	.161	.161	.043	.321	20	29/64	.45313
21	.028	.032	.032	.032	.034	.157	.159	.046	.334	21	15/32	.46875
22	.025	.028	.029	.028	.031	.155	.157	.048	.347	22	31/64	.48438
23	.023	.025	.026	.024	.028	.153	.154	.051	.360	23	1/2	.5
24	.020	.022	.023	.022	.025	.151	.52	.055	.374	24	33/64	.51563
25	.018	.020	.020	.020	.022	.148	.150	.059	.387	25	17/32	.53125
26	.016	.018	.018	.018	.019	.146	.147	.063	.400	26	35/64	.54688
27	.0141	.016	.0173	.0164	.0171	.143	.144	.066	.413	27	9/16	.5625
28	.0126	.014	.0162	.0149	.0156	.139	.141	.072	.426	28	37/64	.57813
29	.0112	.013	.015	.0136	.014	.134	.136	.076	.439	29	19/32	.59375
30	.010	.012	.014	.0124	.0125	.127	.129	.080	.453	30	39/64	.60938
31	.0089	.010	.0132	.0116	.0109	.120	.120		.466	31	5/8	.625
32	.0079	.009	.0128	.0108	.0101	.115	.116		.479	32	41/64	.64063
33	.007	.008	.0118	.010	.0093	.112	.118		.492	33	21/32	.65625
34	.0063	.007	.0104	.0092	.0085	.110	.111		.505	34	43/64	.67188
35	.0056	.005	.0095	.0084	.0078	.108	.110		.518	35	11/16	.6875
36	.005	.004	.009	.0076	.007	.106	.1065		.532	36	45/64	.70313
37	.0044			.0068	.0066	.103	.104		.545	37	23/32	.71875
38	.0039			.006	.0062	.101	.1015		.558	38	47/64	.73438
39	.0035			.0052		.099	.0995		.571	39	3/4	.75
40	.0031			.0048		.097	.098		.584	40	49/64	.76563
41						.095	.096		.597	41	25/32	.78125
42						.092	.094		.611	42	51/64	.79688
43						.088	.089		.624	43	13/16	.8125
44						.085	.086		.637	44	53/64	.82813
45						.081	.082		.650	45	27/32	.84375
46						.079	.081		.663	46	55/64	.85938
47						.077	.079		.676	47	7/8	.875
48						.075	.076		.690	48	57/64	.89063
49						.072	.073		.703	49	29/32	.90625
50						.069	.070		.716	50	59/64	.92188

Letter Sizes Stubbs Steel Wire

A	.234	I	.272	R	.339
B	.238	J	.277	S	.348
C	.242	K	.281	T	.358
D	.246	L	.290	U	.368
E	.250	M	.295	V	.377
F	.257	N	.302	W	.386
G	.261	O	.316	X	.397
H	.266	P	.323	Y	.404
		Q	.332	Z	.413